871-4.

A. I. A. File 29d2

WHITLOCK
STORAGE HEATERS
Type "K"

WHITLOCK
HEAT TRANSFER
EQUIPMENT

Bulletin 40

January 1931

PHILADELPHIA - 2206 Chestnut St.
Phone RITtenhouse 0863

THE WHITLOCK COIL PIPE CO.

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HARTFORD, CONNECTICUT

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Whitlock Engineering Service

WHILE the basic principle of the Whitlock Type "K" Storage Heater constitutes the major factor in all installations, it is necessary to determine the proper size required to meet specific demands and to make a careful analysis of all conditions affecting operations.

Although the necessity and practicability of Whitlock equipment is generally recognized, it is desirable for architects and engineers to call in the nearest Whitlock district engineer, who will make an initial survey of existing conditions or, in relation to plans for a proposed building, will make a careful analysis of such plans, in order to determine the proper size and design of the heater to adequately meet all requirements and operate to maximum economic advantage. This work, by our district engineers, is, in turn, carefully checked by the Engineering Division at Hartford.

Back of this service is a staff of engineers who, in addition to their technical education, have passed through a definite course of training in our own organization — experience in the factory, research laboratory, drafting room, engineering division proper and in the field.

The remarkable effectiveness of the Whitlock Type "K" Storage Heater, as attested by thousands of installations, is due not alone to the soundness of its basic principle and the completeness of our manufacturing facilities, but also to the competent specialized cooperation which we are in a position to render, through our engineering service, in analyzing the requirements of prospective users and determining for them the proper size, and to assist, in many other ways, in bringing about the most practical and economical supply of hot water for all existing needs.

WHITLOCK
HEAT TRANSFER
EQUIPMENT

We are always glad to arrange to have prospective customers inspect typical installations near them.

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Whitlock Type "K" Storage Heaters

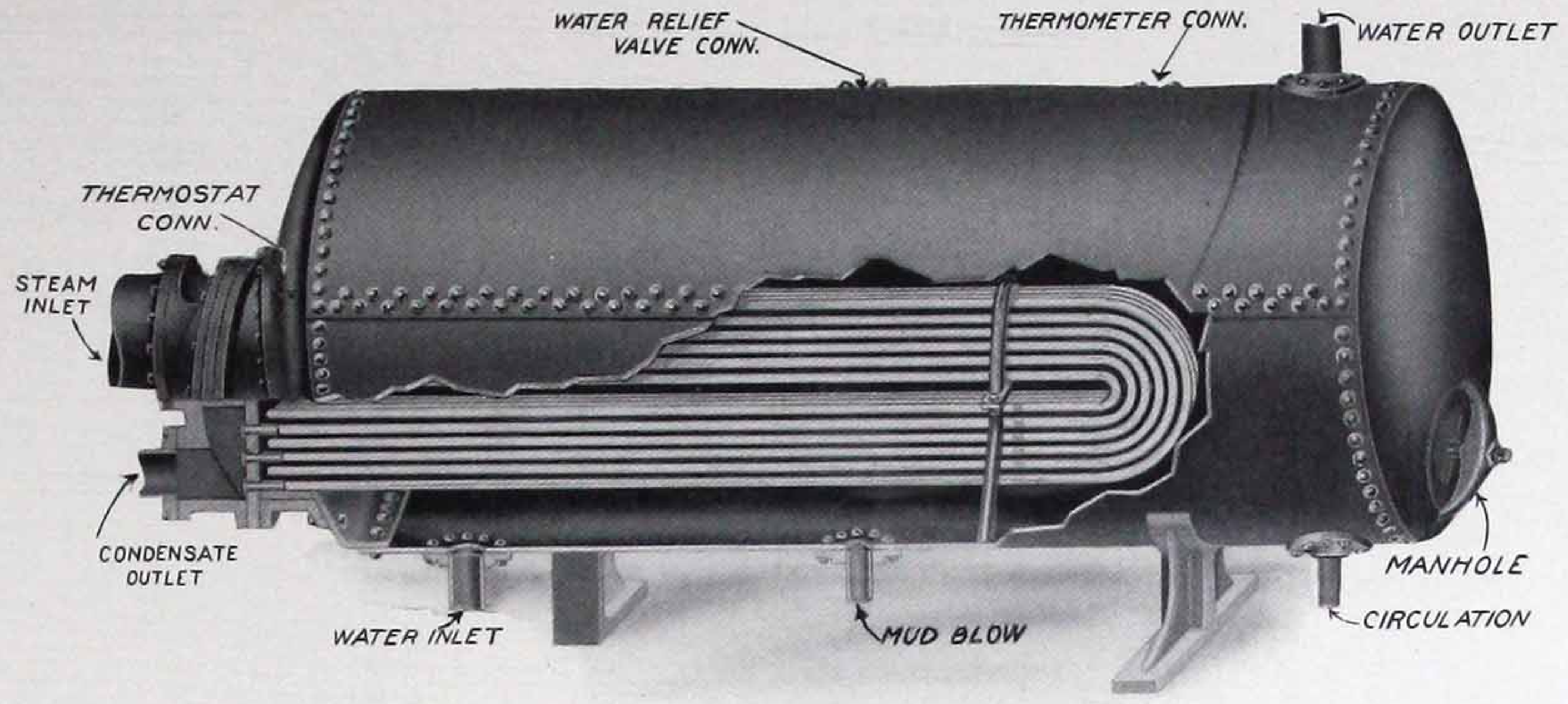

Fig. 1 — Type "K" Heater, Horizontal Design

Whitlock Type "K" Storage Heaters have proved so successful in supplying hot water for many kinds of service, that they have won the approval of owners, architects, engineers and contractors all over the country. This bulletin describes both the services for which they are recommended and the design and construction which has made them successful.

Advantages of Using Storage Heaters

The Whitlock Storage Heater is designed for use in any service where large quantities of hot water are needed at irregular intervals. These heaters, by using steam at a fairly uniform rate, produce hot water continually and recover after heavy drafts so that an ample supply is always available for the next heavy drafts or "peak load".

If there is a supply of exhaust steam available this may be used to good advantage in the storage heater, as this heat can be stored in the form of hot water when otherwise it would necessarily be wasted. If live steam or low pressure steam direct from the boiler is used, the storage principle greatly helps the boiler efficiency by making the steam load more uniform.

Sizes and Capacities of Type "K" Heaters

Table 1, page 2, lists the sizes and capacities of the horizontal storage shells and the heating sections which can be used with them. Table 2 gives the same information for the vertical heaters. After carefully studying the probable hot water demand, and determining the proper proportion between storage capacity and heating capacity, the heater can be easily selected from these tables. Special attention must be paid to the column showing the minimum size shell in which each section will fit.

In referring to Tables 1 and 2, it should be observed that, while these tables specify the thickness of both heads and shell, other thicknesses can be furnished and, indeed, must be furnished if the working water pressure is unusually high. This point should be checked by reference to Table 4, page 4. It is well to remember that the extra life of a heavier shell is well worth the slight additional first cost, especially under certain water conditions.

General Design of Type "K" Heaters

These heaters are of the steam actuated type and consist of a storage "shell" in which is installed a removable copper tube heating section. Leaving a general description of the details and materials of construction to a later page, it is well to mention here some of the design features. The seamless copper tube interior heating section, for example, is located low in the shell so that it is always in contact with the coldest water. As the water becomes heated it seeks a higher level within the shell and becomes stored in the upper portion of the shell. Thus the heating process is carried on with greater uniformity and speed and this arrangement makes it impossible for water to enter and leave the heater without being subjected to the heating process.

The heating section consists of a number of U-bends of seamless copper tubing arranged so as to give the minimum resistance to the flow of steam, a very important factor. The use of copper insures the maximum effectiveness of the heating surface and also its maximum life. The use of the U-bend construction provides the best possible means of taking care of expansion and contraction due to temperature changes.

This section can be readily removed when inspection or cleaning is necessary. The location of the manhole, low in the rear head, also aids in inspecting

(Continued on page 4)

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Dimensions, Capacities and Weights

TABLE NO. 1 — HORIZONTAL

SHELLS						HEATING SECTIONS				
Size No.	Storage Capacity Gallons	Diameter and Length	Thickness of Shell	Thickness of Head	Weight of Shell	Symbol No.	Capacity Gallons per Hour	Maximum Size Steam Pipe In.	Smallest Shell into which Section will Fit, In.	Weight of Entire Heating Section Lbs.
1	65	18x 60	¼	⅜	400	H 0	100	2	18x 48	75
2	80	18x 72	¼	⅜	450	H 1	150	2	18x 60	80
3	118	24x 60	¼	⅜	600	H 2	200	2	18x 72	90
4	141	24x 72	¼	⅜	700	H 3	250	3½	18x 48	175
5	164	24x 84	¼	⅜	800	H 4	300	3½	18x 48	185
6	185	30x 60	¼	⅜	750	H 5	350	3½	18x 60	190
7	220	30x 72	¼	⅜	850	H 6	400	3½	18x 60	200
8	255	30x 84	¼	⅜	950	H 7	500	3½	18x 72	210
9	290	30x 96	¼	⅜	1050	H 8	550	3½	18x 72	215
10	365	36x 84	5/16	½	1300	H 9	600	3½	18x 84	220
11	420	36x 96	5/16	½	1450	H10	700	5	24x 60	300
12	475	36x108	5/16	½	1600	H11	800	3½	18x 96	260
13	525	36x120	5/16	½	1800	H12	900	3½	18x108	270
14	575	42x 96	5/16	½	1850	H13	1000	3½	18x120	285
15	720	42x120	5/16	½	2150	H14	1250	5	24x 84	370
16	860	42x144	5/16	½	2500	H15	1500	5	24x108	425
17	1000	42x168	5/16	½	2900	H16	1750	5	24x120	450
18	950	48x120	⅜	½	2850	H17	2000	6	30x 96	570
19	1140	48x144	⅜	½	3250	H18	2400	6	30x120	620
20	1310	48x168	⅜	½	3700	H19	2800	6	30x132	670
21	1480	48x192	⅜	½	4100	H20	3200	8	36x 96	860
22	1190	54x120	⅜	½	3250	H21	3600	8	36x108	920
23	1430	54x144	⅜	½	3700	H22	4000	8	36x120	950
24	1670	54x168	⅜	½	4200	H23	4400	8	36x132	1020
25	1900	54x192	⅜	½	4700	H24	4800	10	36x 96	1200
26	1420	60x120	7/16	9/16	4300	H25	5400	10	36x108	1300
27	1710	60x144	7/16	9/16	4900	H26	6000	10	36x120	1380
28	2000	60x168	7/16	9/16	5600	H27	7000	12	42x 96	1950
29	2300	60x192	7/16	9/16	6200	H28	8000	12	42x 96	2000
30	2460	72x144	7/16	9/16	5700	H29	9000	12	42x108	2300
31	2880	72x168	7/16	9/16	6400	H30	10000	12	42x108	2460
32	3310	72x192	7/16	9/16	7300	H31	11000			
33	3730	72x216	7/16	9/16	8000	H32	12000			
34	3900	84x168	½	⅝	8700	H33	13000			
35	4480	84x192	½	⅝	9650	H34	14000			
36	5060	84x216	½	⅝	10800	H35	15000			
37	5640	84x240	½	⅝	11800	H36	16000			
38	5820	96x192	½	⅝	11100	H37	17000			
39	6570	96x216	½	⅝	12500	H38	18000			
40	7320	96x240	½	⅝	13500	H39	19000			
41	8070	96x264	½	⅝	14500	H40	20000			
42	7350	108x192	9/16	⅝	13100					
43	8300	108x216	9/16	⅝	14700					
44	9250	108x240	9/16	⅝	15900					
45	10200	108x264	9/16	⅝	17200					

TABLE NO. 2 — VERTICAL

SHELLS						HEATING SECTIONS				
Size No.	Storage Capacity Gallons	Diameter and Height	Thickness of Shell	Thickness of Head	Weight of Shell	Symbol No.	Capacity Gallons per Hour	Steam Conn. In.	Min. Shell Diam. Sec. Will Fit, In.	Weight of Entire Section Lbs.
1V	65	18x 60	¼	⅜	520	HV 1	150	3½	18	160
2V	80	18x 72	¼	⅜	570	HV 2	200	3½	24	170
3V	118	24x 60	¼	⅜	630	HV 3	250	5	18	250
4V	141	24x 72	¼	⅜	800	HV 4	300	5	24	255
5V	164	24x 84	¼	⅜	880	HV 5	350	5	24	260
6V	185	30x 60	¼	⅜	900	HV 6	400	6	24	335
7V	220	30x 72	¼	⅜	980	HV 7	500	6	24	340
8V	255	30x 84	¼	⅜	1080	HV 8	550	6	24	350
9V	290	30x 96	¼	⅜	1170	HV 9	600	6	24	360
10V	365	36x 84	5/16	½	1610	HV10	700	6	30	375
11V	420	36x 96	5/16	½	1740	HV11	800	6	36	385
12V	475	36x108	5/16	½	1880	HV12	900	6	36	400
13V	525	36x120	5/16	½	2000	HV13	1000	6	42	415
14V	575	42x 96	5/16	½	2050	HV14	1250	8	36	570
15V	720	42x120	5/16	½	2350	HV15	1500	8	42	600
16V	860	42x144	5/16	½	2680	HV16	1750	10	36	790
17V	1000	42x168	5/16	½	3000	HV17	2000	10	42	830
18V	950	48x120	⅜	½	2970	HV18	2400	10	48	880
19V	1140	48x144	⅜	½	3370	HV19	2800	12	42	1340
20V	1310	48x168	⅜	½	3950	HV20	3200	12	42	1430
21V	1480	48x192	⅜	½	4270	HV21	3600	12	48	1470
22V	1190	54x120	⅜	½	4020	HV22	4000	12	48	1510
23V	1430	54x144	⅜	½	4520	HV23	4400	12	54	1560
24V	1670	54x168	⅜	½	5020	HV24	4800	12	54	1600
25V	1900	54x192	⅜	½	5620	HV25	5400	12	60	1700
26V	1420	60x120	7/16	9/16	4230	HV26	6000	14	48	
27V	1710	60x144	7/16	9/16	4880	HV27	7000	14	54	
28V	2000	60x168	7/16	9/16	5620	HV28	8000	14	60	
29V	2300	60x192	7/16	9/16	6320	HV29	9000	14	66	
						HV30	10000	14	72	

Capacity based on Heating from 40° to 180° with Steam at 0 lbs. Gage Pressure. For other temperatures and Steam Pressures see Bulletin No. 27.

DIRECTIONS FOR USE — Select the size storage you require and combine its designating number with the number which designates the desired hourly output. Assuming a required storage of 1,000 gallons (No. 17 shell 42 x 168) and a required hourly output of 1,750 gallons (No. H16 Heating Unit) you would specify a Whitlock Type "K", No. 17H16.

Roughing-in Dimensions for Horizontal Type "K" Heaters

SHELL SIZES 1-31, HEATING SECTION SIZES H0 to H30

Roughing-in dimensions for larger or special sizes or for vertical type "K" heaters, will be furnished promptly on request.

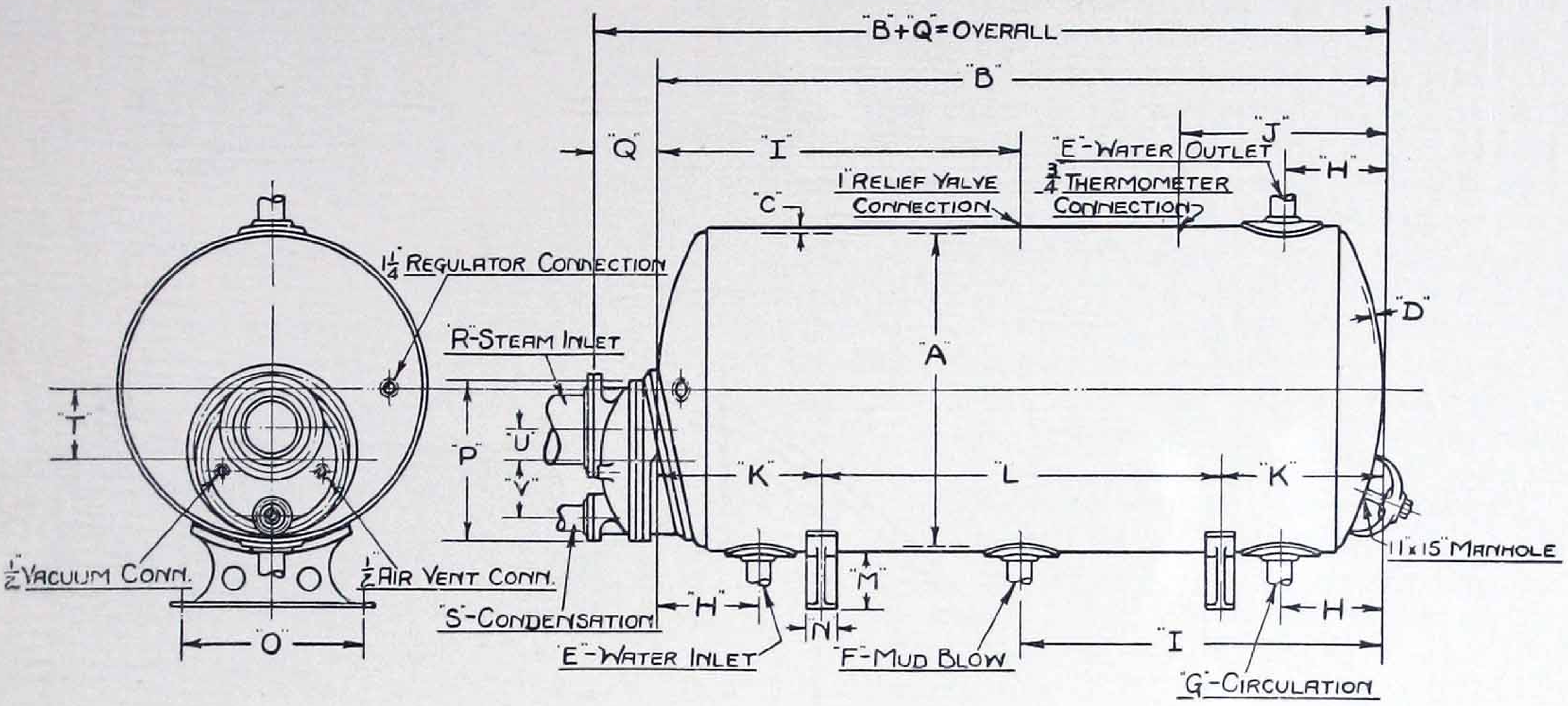


TABLE NO. 3 — WHITLOCK TYPE "K" STORAGE HEATERS (HORIZONTAL)

SHELLS																					HEATING SECTIONS										
															Standard cradles			Pipe leg cradles													
No.	Gallons — one filling	"A" Diam., in.	"B" Length, in., add "Q" for over all	"C" Thickness of shell	"D" Thickness of head, in.	Weight, lb.	"E" Water inlet and outlet, in.	"F" Mud blow, in.	"G" Circulation, in.	"H" Location of water connection, in.	"I" Location of mud blow, in.	"J" Location of thermometer, in.	"K" Location of cradles, in.	"L" c. c. of cradles	"M" Height, in.	"N" c. c. of bolt holes, in.	"O" c. c. of bolt holes, in.	"M" Height, in.	"N" Diam. of pipe legs, in.	"O" c. c. of pipe legs, in.	No.	Gallons per hour	Smallest shell into which section will fit, in.	Weight of entire section, lb.	"P" Diam. of head port, in.	"Q" Add to "B" for over all, in.	"R" Max. and std. steam inlet, in.	"S" Max. and std. condensation	"T" Center heater to center of section	"U" Location of steam inlet, in.	"V" Location of cond. outlet, in.
1	65	18	60	¼	⅜	400	2	2	...	10	30	22	18	24	4	1½	11	2	1½	15	H0	100	18x48	75	9¼	6¼	2	1	½ "A" — ½ "P" or ½ Diam. Shell Minus ½ Diam. Head Port	1 7/16	2½
2	80	18	72	¼	⅜	450	2	2	...	10	36	22	18	36	4	1½	11	2	1½	15	H1	150	18x60	80	9¼	6¼	2	1		1 7/16	2½
3	118	24	60	¼	⅜	600	2	2	...	11	30	23	19	22	6	1¾	14	2½	2	17	H2	200	18x72	90	9¼	6¼	2	1		1 7/16	2½
4	141	24	72	¼	⅜	700	2	2	...	11	36	23	19	34	6	1¾	14	2½	2	17	H3	250	18x48	175	12½	7½	3½	2		2¾	3½
5	164	24	84	¼	⅜	800	2	2	...	11	42	23	19	46	6	1¾	14	2½	2	17	H4	300	18x48	185	12½	7½	3½	2		2¾	3½
6	185	30	60	¼	⅜	750	3	2	...	12	30	24	20	20	7	1¾	19	3	2	22	H5	350	18x60	190	12½	7½	3½	2		2¾	3½
7	220	30	72	¼	⅜	850	3	2	...	12	36	24	20	32	7	1¾	19	3	2	22	H6	400	18x60	200	12½	7½	3½	2		2¾	3½
8	255	30	84	¼	⅜	950	3	2	...	12	42	24	20	44	7	1¾	19	3	2	22	H7	500	18x72	210	12½	7½	3½	2		2¾	3½
9	290	30	96	¼	⅜	1050	3	2	...	12	48	24	20	56	7	1¾	19	3	2	22	H8	550	18x72	215	12½	7½	3½	2		2¾	3½
10	365	36	84	5/16	½	1300	3	2	...	14	42	26	22	40	8	1¾	21½	3½	2½	25½	H9	600	18x84	220	12½	7½	3½	2		2¾	3½
11	420	36	96	5/16	½	1450	3	2	...	14	48	26	22	52	8	1¾	21½	3½	2½	25½	H10	700	24x60	300	15¼	7½	5	2		2¾	4½
12	475	36	108	5/16	½	1600	3	2	...	14	54	26	22	64	8	1¾	21½	3½	2½	25½	H11	800	18x96	260	12½	7½	3½	2		2¾	3½
13	525	36	120	5/16	½	1800	3	2	2	14	60	26	22	76	8	1¾	21½	3½	2½	25½	H12	900	18x108	270	12½	7½	3½	2		2¾	3½
14	575	42	96	5/16	½	1850	4	2	...	17	48	29	26	44	8	2	25½	3 7/16	3	26	H13	1000	18x120	285	12½	7½	3½	2		2¾	3½
15	720	42	120	5/16	½	2150	4	2	2	17	60	29	26	68	8	2	25½	3 7/16	3	26	H14	1250	24x84	370	15¼	7½	5	2		2¾	4½
16	860	42	144	5/16	½	2500	4	2	2	17	72	29	26	92	8	2	25½	3 7/16	3	26	H15	1500	24x108	425	15¼	7½	5	2		2¾	4½
17	1000	42	168	5/16	½	2900	4	2	2	17	84	29	26	116	8	2	25½	3 7/16	3	26	H16	1750	24x120	450	15¼	7½	5	2		2¾	4½
18	950	48	120	⅜	½	2850	4	2	2	18	60	30	27	66	9	2	29	4	3	24½	H17	2000	30x96	570	18¼	8½	6	2½		3¼	5½
19	1140	48	144	⅜	½	3250	4	2	2	18	72	30	27	90	9	2	29	4	3	24½	H18	2400	30x120	620	18¼	8½	6	2½		3¼	5½
20	1310	48	168	⅜	½	3700	4	2	2	18	84	30	27	114	9	2	29	4	3	24½	H19	2800	30x132	670	18¼	8½	6	2½		3¼	5½
21	1480	48	192	⅜	½	4100	4	2	2	18	96	30	27	138	9	2	29	4	3	24½	H20	3200	36x96	860	21	9⅜	8	2½		4 5/16	6⅞
22	1190	54	120	⅜	½	3250	4	2	2	20	60	32	30	60	9	2	33	4½	4	27	H21	3600	36x108	920	21	9⅜	8	2½		4 5/16	6⅞
23	1430	54	144	⅜	½	3700	4	2	2	20	72	32	30	84	9	2	33	4½	4	27	H22	4000	36x120	950	21	9⅜	8	2½		4 5/16	6⅞
24	1670	54	168	⅜	½	4200	4	2	2	20	84	32	30	108	9	2	33	4½	4	27	H23	4400	36x132	1020	21	9⅜	8	2½		4 5/16	6⅞
25	1900	54	192	⅜	½	4700	4	2	2	20	96	32	30	132	9	2	33	4½	4	27	H24	4800	36x96	1200	24	9⅝	10	3		5 5/16	8⅛
26	1420	60	120	7/16	9/16	4300	4	2	2	20	60	32	30	60	10	2	37	4½	4	31	H25	5400	36x108	1300	24	9⅝	10	3		5 5/16	8⅛
27	1710	60	144	7/16	9/16	4900	4	2	2	20	72	32	30	84	10	2	37	4½	4	31	H26	6000	36x120	1380	24	9⅝	10	3		5 5/16	8⅛
28	2000	60	168	7/16	9/16	5600	4	2	2	20	84	32	30	108	10	2	37	4½	4	31	H27	7000	42x96	1950	30	11⅞	12	4		6½	10½
29	2300	60	192	7/16	9/16	6200	4	2	2	20	96	32	30	132	10	2	37	4½	4	31	H28	8000	42x96	2000	30	11⅞	12	4		6½	10½
30	2460	72	144	7/16	9/16	5700	4	2½	2½	23	72	35	34	76	8	2⅛	40	8	4	39	H29	9000	42x108	2300	30	11⅞	12	4		6½	10½
31	2880	72	168	7/16	9/16	6400	4	2½	2½	23	84	35	34	100	8	2⅛	40	8	4	39	H30	10000	42x103	2460	30	11⅞	12	4		6½	10½

(Continued from page 1)

and cleaning the heater. (Fig. 8) page 13.

Whitlock Storage Heaters are designed for all conditions of service. The type most generally furnished is the horizontal design (Fig. 1) with the single heating section suitable for use with either live or exhaust steam.

If space is limited it is occasionally necessary to install a vertical heater (Fig. 2) where the installation of the horizontal heater is impossible. The construction details are the same, with the copper tube heating section low in the shell and directly above the cold water inlet. This heater may rest on pipe legs attached to brackets riveted to the shell, as illustrated in Fig. 2, or the brackets may rest directly on I-beam supports. Still another method, which has been used successfully, is to rest the heater on reinforced concrete piers shaped to conform to the contour of the bottom head.

In many instances there is a supply of exhaust steam available for heating, which takes the largest share of the load. If the supply of exhaust steam is insufficient to heat all the water required, live steam, under thermostatic control, may be admitted to the auxiliary section of the combination Type "K" Heater illustrated in Fig. 5. The thermostatic valve controls the supply of live steam, admitting sufficient to supplement the exhaust steam during periods of high or peak load and diminishing or cutting off entirely the supply of live steam during periods of moderate or minimum load, when the exhaust steam is nearly or quite able to supply all the heat required. Vertical heaters are also furnished of the combination design, with an auxiliary section located in the upper part of the shell.

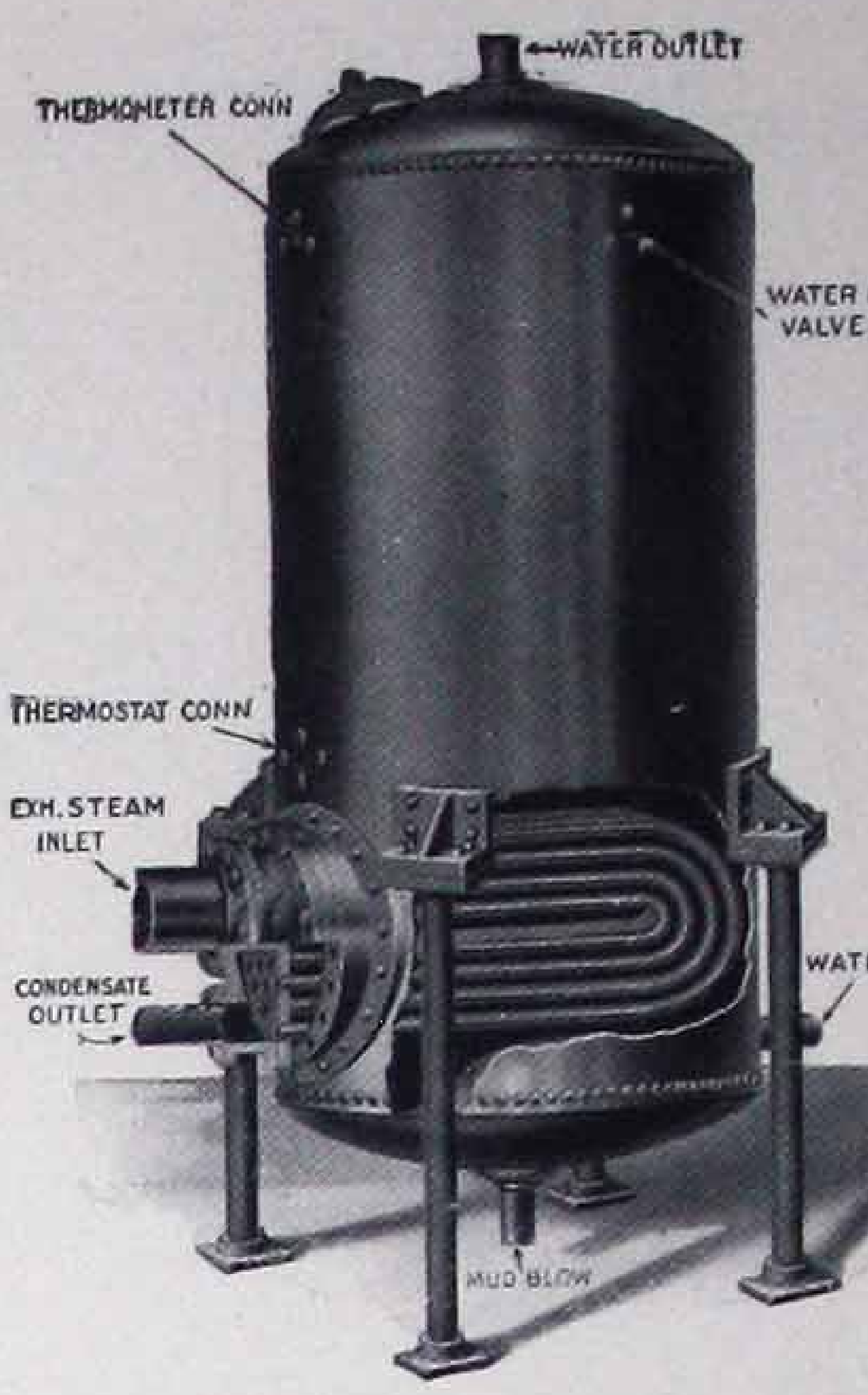


Fig. 2 — Type "K" Heater, Vertical Design

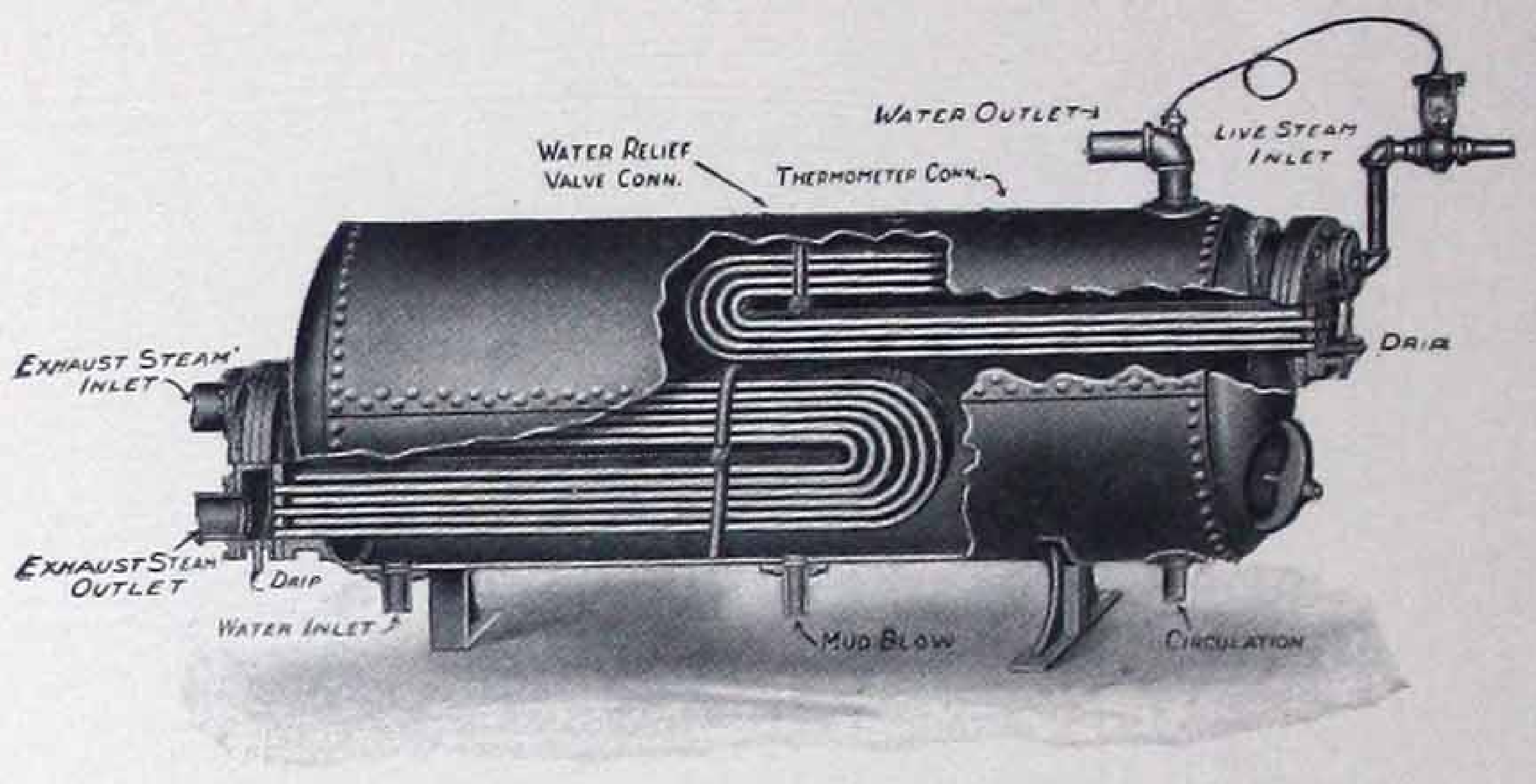


Fig. 5 — Type "K" Heater — Combination Design with Auxiliary Heating Section

TABLE NO. 4
MAXIMUM ALLOWABLE WORKING PRESSURE

Diam. of Shell	THICKNESS OF SHELL							
	¼	5/16	⅜	7/16	½	9/16	⅝	
18	185	232	...	...	...	...	...	Longi. seam single riveted lap
24	139	170	200	...	...	...	...	
30	127	159	189	219	...	...	...	Longi. seam double riveted lap
36	106	132	158	183	219	...	...	
42	91	113	135	157	179	...	...	
48	80	99	118	137	157	...	...	
54	71	87	105	122	139	...	...	
60	64	79	95	110	125	...	...	
72	53	66	79	92	104	...	...	
84	...	57	68	79	90	...	...	
96	...	...	59	69	79	...	...	
108	...	...	...	61	70	...	...	
60	76	94	112	130	149	167	185	Longi. seam double riveted double butt strapped joint
72	63	78	94	108	124	139	154	
84	...	67	81	93	106	119	132	
96	...	...	71	81	93	104	115	
108	...	...	...	72	83	92	102	
96	...	...	...	87	101	111	123	Longi. seam triple riveted double butt strapped joint
108	...	...	...	78	90	99	110	

Note: Above working pressures are based on a tensile strength of 55,000 pounds per square inch and a factor of safety of five with shell seams designed as recommended by the Hartford Steam Boiler Inspection and Insurance Co.

Larger size heaters are designed for the particular conditions under which they are to operate.

This table will be of service in determining proper shell thickness to include in specification shown on page 15.

Dimensions and capacities of heaters for the usual water pressures will be found on page 2.

TABLE NO. 5

Hot Water Fixture Capacities for Various Types of Buildings

FIGURED AT A FINAL TEMPERATURE OF 180° FAHRENHEIT
GALLONS OF WATER PER HOUR PER FIXTURE

	Apartment House	Club	Gymnasium	Hospital	Hotel	Industrial Plant	Office Building	Public Bath	Private Residence	School	Y. M. C. A.
Basins, Private Lavatory	2	2	2	2	2	2	2	2	2	2	2
Basins, Public Lavatory	4	6	8	6	8	12	6	12	..	15	8
Bath Tubs	20	20	30	20	20	30	..	45	20	..	30
Dish Washers	15	50-150	..	50-150	50-200	20-100	..	..	15	20-100	20-100
Foot Basins	3	3	12	3	3	12	..	..	3	3	12
Kitchen Sink	10	20	..	20	20	20	..	..	10	10	20
Laundry, Stationary Tubs	20	28	..	28	28	..	..	..	20	..	28
Pantry Sink	5	10	..	10	10	..	..	..	5	10	10
Showers	75	150	225	75	75	225	..	225	75	225	225
Slop Sink	20	20	..	20	30	20	15	15	15	20	20
Hourly Heating Capacity Factor	30%	30%	40%	25%	25%	40%	30%	50%	30%	40%	40%
Storage Capacity Factor	125%	90%	100%	60%	80%	100%	200%	120%	70%	100%	100%

The size of Whitlock Type "K" Storage Heater required for a certain building can be found from this table as follows:
Hourly heating capacity = Hourly requirements from table × Hourly heating capacity factor.
Storage capacity = Hourly heating capacity × Storage capacity factor.
Reference to the tables on page 2 will show correct size of shell and heating section at once.

To illustrate the above method of selecting the proper heater, we will take the hot water requirements of a small hotel.

Private lavatories	100 @	2 gals. each	200 gals. per hr.
Public lavatories	10 @	8 gals. each	80 gals. per hr.
Bathtubs	75 @	20 gals. each	1500 gals. per hr.
Dishwashers	2 @	30 gals. each	60 gals. per hr.
Kitchen sinks	3 @	20 gals. each	60 gals. per hr.
Pantry sinks	3 @	10 gals. each	30 gals. per hr.
Showers	24 @	75 gals. each	1800 gals. per hr.
Slop sinks	9 @	30 gals. each	270 gals. per hr.
Maximum hourly requirements (total)			4000 gals. per hr.

Hourly heating capacity equals 4000 multiplied by 25% or 1000 gal. per hour.

Storage capacity equals 1000 multiplied by 80% or 800 gal.

Nearest shell size to 800 gal. is 860, No. 16 (42 x 144 in.). Heating section of 1000 gal. capacity is No. H13. Heater required is then Whitlock Type "K" No. 16H13.

Classification of Type "K" Storage Heaters

The use of Type "K" Storage Heaters is divided into two main classifications, "service" and "process", and these terms will be used in this and various other bulletins describing Whitlock Water Heaters.

"Service" water heaters are those which supply water for toilet purposes, i.e., for tub and shower bath, hand basins, slop sinks, etc. Generally included in this class is hot water for kitchen uses. Examples of this class of installations are hotels, apartment houses, residences, office and other commercial buildings, institutions such as Y. M. C. A.'s, clubs, schools, hospitals, etc.

The term "process" water heater is applied to those which supply water used in connection with manufacturing operations and processes. Examples of this classification are installations in textile mills (including bleaching, dyeing and finishing plants) of all kinds such as woolen, cotton, silk, etc., power laundries, leather plants, paper mills, dairies and creameries and many chemical manufacturing and food plants.

In connection with industrial concerns the Whitlock Type "K" Storage Heater is playing a tremendously important part in furthering efficiency of production. Where the demand for hot water is very large and where manufacturing efficiency is dependent upon the supply, the Whitlock Type "K" Heaters have proven themselves not only highly efficient but have become indispensable for this purpose.

The textile mills are outstanding examples of an industry which has been very adequately served by Whitlock equipment, requiring, as it does, great volumes of hot water, an adequate and reliable supply of which is essential for rapid and economical production.

The dairy industry, to cite another example, is one in which Whitlock Type "K" Heaters are used extensively and their application in dairies, in connection with the pasteurizing process, can only be briefly mentioned here, but the major advantages of the Whitlock system are economy, accurate temperature control and adaptability.

Steam laundries require large volumes of hot water and a means of assuring a large supply for "peak load" periods. The effectiveness of Whitlock Type "K" Storage Heaters in relation to this class of business is being attested by hundreds of laundries.

Constant Improvement

The Whitlock Type "K" Storage Heater of today is the culmination of years of determination to produce the most efficient device of its kind. Although the basic principle has proven itself to be sound we have continually incorporated improvements which have been originated and developed by a carefully trained staff of engineers, who have made a close study of water heating problems and water heaters, through three principle mediums:

— knowledge of operating conditions and results in the field, i.e., actual operations.

— selected and exhaustive series of tests carried on in our own research laboratory.

— study and analysis of the current technical writings by authorities, throughout the country, on this and allied subjects, and a never ceasing observation and study of all phases of the water heating industry.

Some of the important improvements, covering a period of years, are as follows:

Whitlock Type "K" heaters were the first storage type heaters, or service water heaters of any type, to be built with copper tubes. Seamless drawn copper tubing, on account of its higher heat conductivity and greater mechanical reliability (as compared with brass tubing) has been used in the heating sections of Whitlock Type "K" Heaters for about fifteen years except, of course, for certain special heaters for handling liquids other than water, in which case special alloy tubing, of various kinds, has been used.

The establishment of the optimum length and spacing of tubes in the heating sections. These figures were determined by a now classic series of experiments made in our research laboratory.

The demonstration of the correct arrangement of water inlet and outlet connections for such storage heaters. This also was established by a series of tests in our laboratory, about ten years ago, which completely revolutionized previous ideas on this point.

In addition to the above mentioned developments, others, of course, have been made from time to time. Needless to say the results of these exhaustive experiments have been subsequently incorporated in the standard design of Type "K" Storage Heaters.

This subject should not be dismissed without reference to the "Hot Water Fixture Capacity Table", (Table 5) first compiled and issued fifteen years ago by this company. This was the first effort, as far as we know, to collect and tabulate any comprehensive data on this subject. It has since been reissued several times by us, each new issue incorporating certain additions and corrections dictated by additional data which we have determined or collected in the meantime. It has also been widely copied and used by engineers, manufacturing concerns and publications all over the country.

Two Recent Improvements

Within the past two or three years the design of bumped heads, for maximum and uniform strength, has received a considerable amount of attention at the hands of a few engineers and organizations interested in the design and construction of pressure vessels.

Any detailed account of this work and its results would be out of place here but we simply wish to call attention to the fact that perhaps the most careful experiments made along these lines have indicated that a semi-ellipsoidal bumped head is one of uniform strength, having no tendency to deform under internal pressure.

In the standard bumped head the relatively small knuckle radius, where the bumped head proper joins the straight flange, has generally been the weakest point. Within the last year we have worked out, and adopted as standard for the bumped heads on all Whitlock Type "K" Heaters, a design which approximates very closely to this true semi-ellipsoidal form. This design of head overcomes the structural faults of the standard bumped head which has been universally used for pressure vessels in the past.

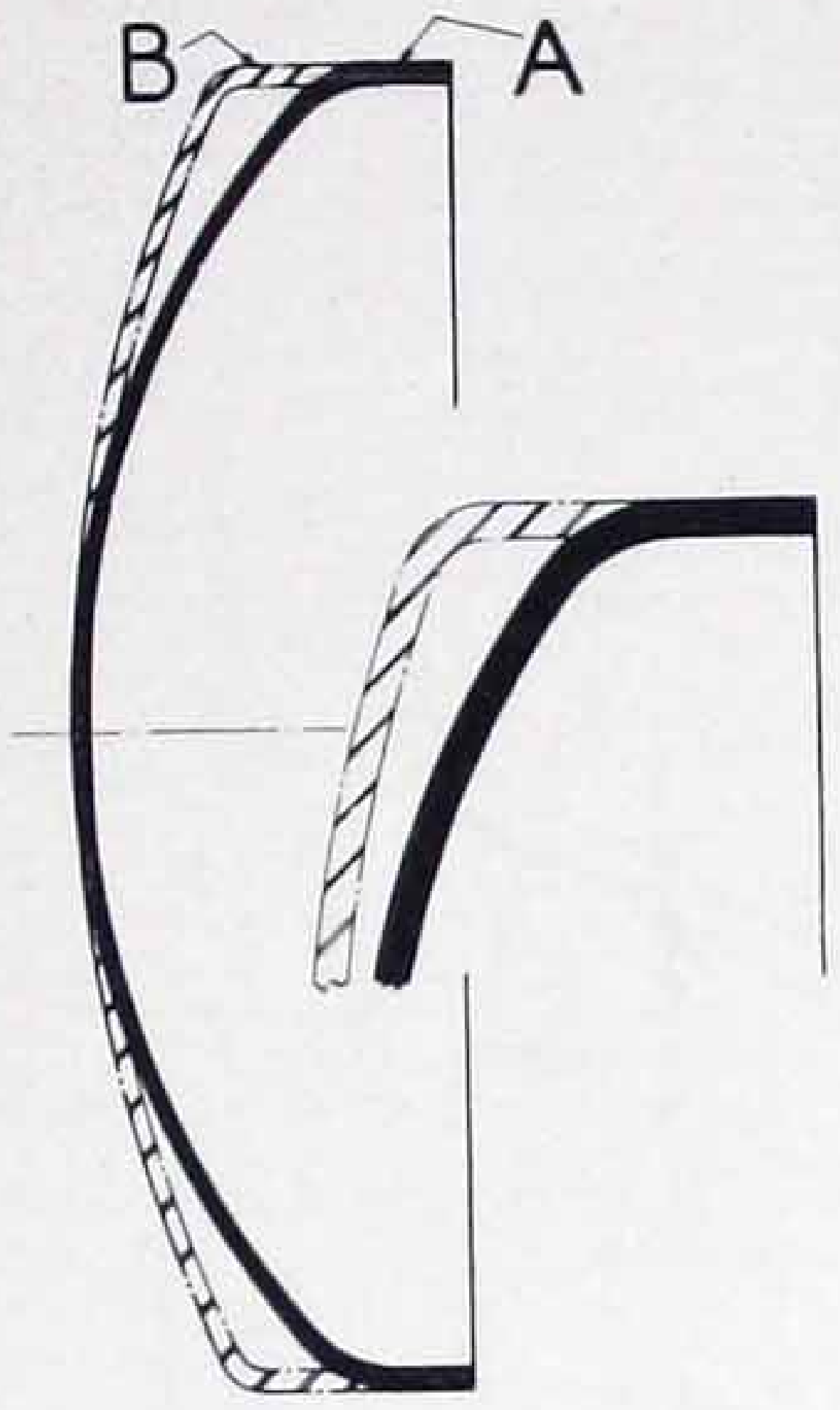


Fig. 3 — Comparative Head Contours

A. Solid black section shows contour of Whitlock Bumped Head

B. Light, cross-hatched section shows contour of Standard Bumped Head

Another recent development which contributes to the permanent and complete mechanical efficiency of the Type "K" Heater is the design of the tube support and spacer. Note illustration, (Fig. 4). This element is made of solid bronze and is provided with ample bearing surfaces for the tubes and with all holes carefully chamfered on both sides of the plate.

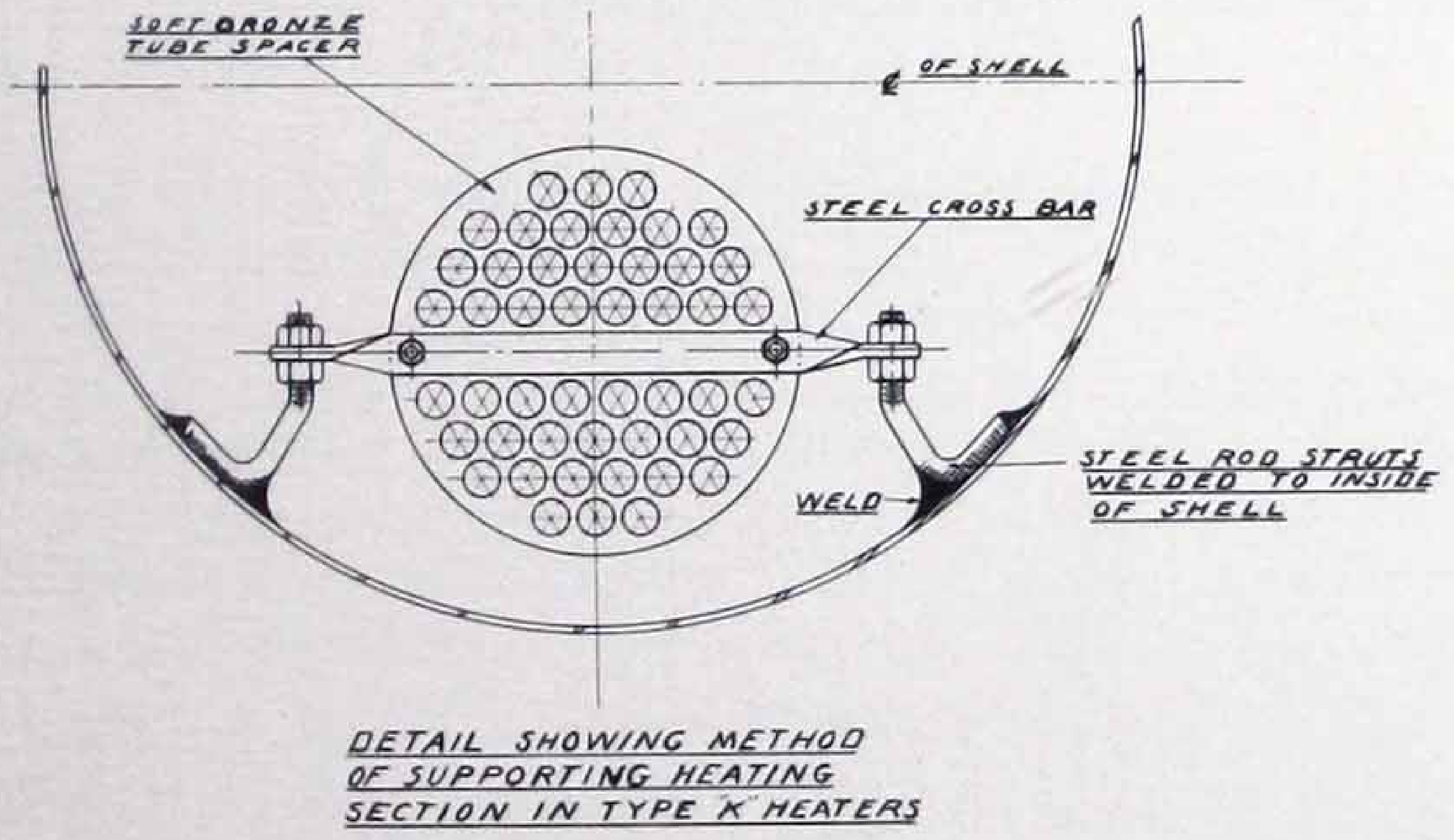

SOFT BRONZE TUBE SPACER
℄ OF SHELL
STEEL CROSS BAR
STEEL ROD STRUTS WELDED TO INSIDE OF SHELL
WELD
DETAIL SHOWING METHOD OF SUPPORTING HEATING SECTION IN TYPE "K" HEATERS

Fig. 4 — Tube Support and Spacer

This provides a full spacer and support which is firmly held by means of a heavy member rigidly secured to the tube support plate and attached to substantial vertical struts which, in turn, are welded to the shell. This important development is now incorporated as standard on all Whitlock Type "K" Heaters having sections long enough to require support.

Whitlock Type "K" Submerged Heaters

Whitlock Type "K" Submerged Heaters are installed so that the copper tube heating element is below the water line in the steam boiler (Fig. 6). Boiling water from the steam boiler heats the domestic service supply with a steady transfer of heat which produces a constant storage of hot water in the Type "K" Heater.

In the Whitlock Submerged Type "K" Heater a small but never ceasing draft of heat from the water of the steam boiler occurs regardless of the condition of the fire — intensely hot or just banked. Furthermore, the small amount of heat is taken in such a way (water-to-water, slow transfer of heat) that in the average heating plant, it does not reduce the steaming capacity of the boiler appreciably.

In the submerged heater the saving, compared to steam heating coils, is explained by the fact that the heat used, to a certain extent, is heat that is otherwise wasted continuously in all boilers by uneven firing, overproduction of steam, overheating of water, and overheating of buildings. Compared to the separate coal fired or gas fired water heaters, there is the added economy and the advantage of one less fire to pay for and attend to.

Besides the fuel economy and more satisfactory service given by this new method of heating water, there are other advantages that are worth considering.

1. **The lower head** room required does away with the necessity of additional excavation, which is a real saving.
2. **Condensation return troubles are totally eliminated** because no steam traps or return pumps are needed — also saving the first cost of these accessories.
3. **Hot water is available at all hours,** including those early in the morning, because the heating goes on all night while the fires are banked.
4. **No automatic temperature control** is necessary with this water-to-water method of heating as the circulation is retarded when the temperature of the domestic supply approaches that of the heating boiler.
5. **The summer heater may be eliminated** in some cases, even during summer time, by blanking off all but a small section of the grate in the house heating boiler.
6. **The danger of breakage,** which comes where cast iron sectional boilers are subjected to the full service water pressure, is done away with because, in this Indirect Method, the heating water, circulating between the heating boiler and the tube section of the Submerged Water Heater, is at a very low pressure.

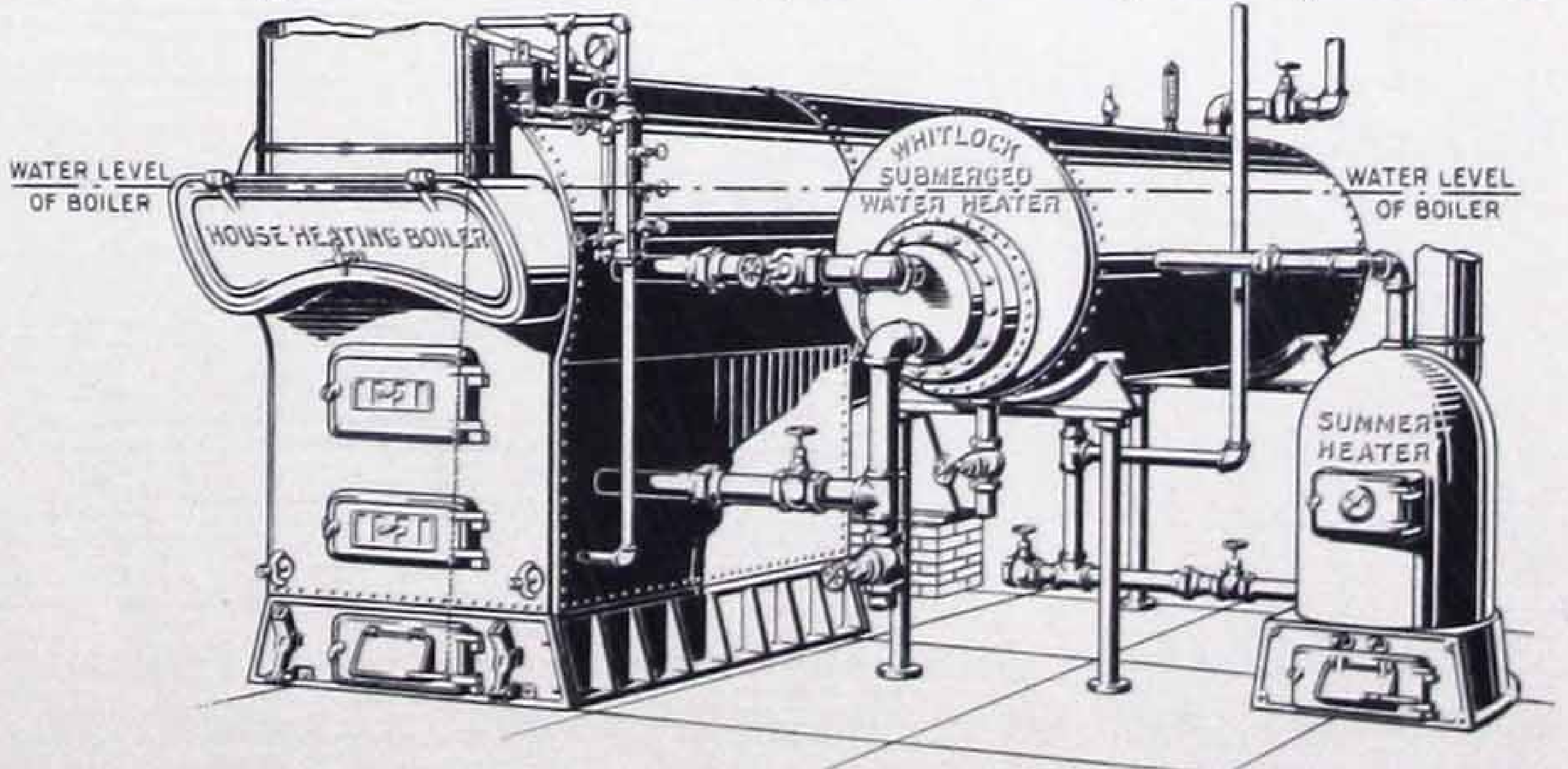


Fig. 6 — Installation of Whitlock Submerged Heater

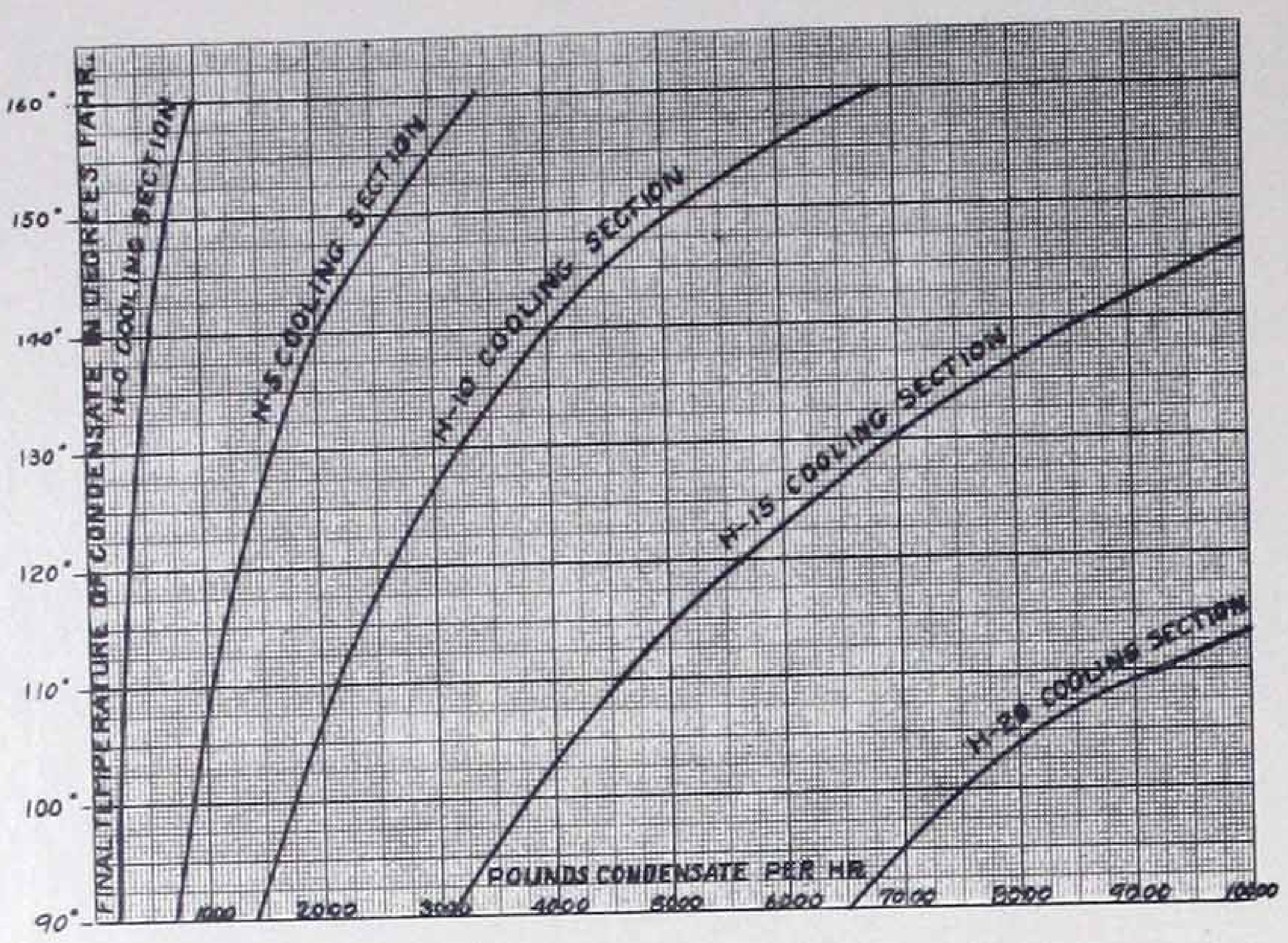
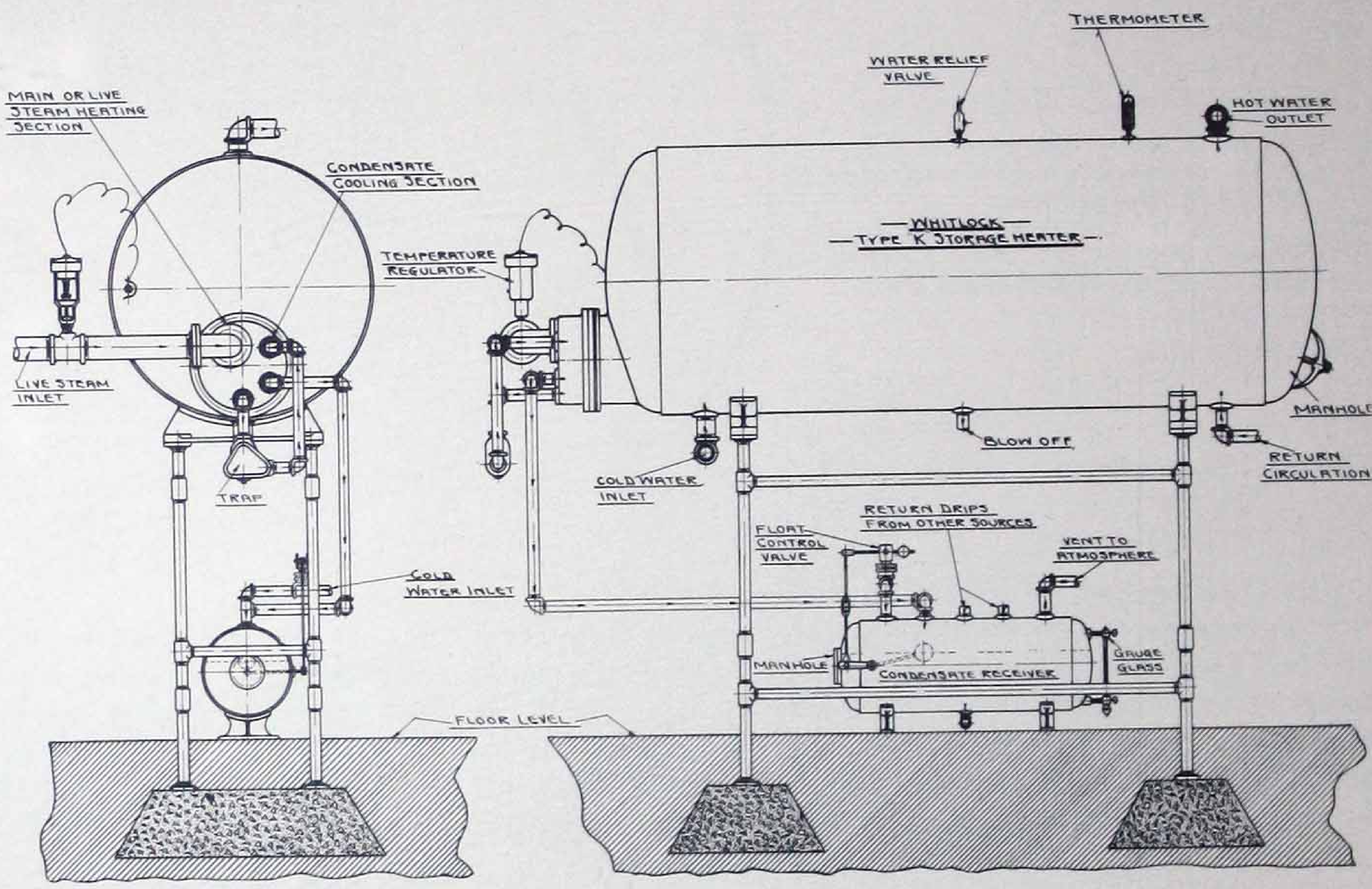


Chart showing capacities of Type "K" condensation cooling sections under varying operating conditions.



Typical layout of Type "K" Heater with combined heating and condensation cooling section — handling condensation from heating section only

Type "K" Condensation Coolers

Whitlock Type "K" Condensation Coolers or Economizers are of the same general construction as the standard heaters but make use of the heat in the condensation returns from the steam heating system, or other sources, instead of live steam direct from the boiler. By properly proportioning the amount of heating surface the available drips are discharged substantially cold.

Where steam is purchased from an outside source for use in hotels, hospitals, schools, etc., it is usually impractical to return the condensation to the power plant from which steam is purchased, and it becomes necessary to throw it away. It is frequently illegal, however, and always inadvisable, to discharge hot condensation to the sewer. Furthermore, it is decidedly worth while to recover the heat content before discharging it.

Where the amount of condensate available is insufficient to furnish all of the heat necessary, an auxiliary steam heating section is also required.

To meet the demands for an economizer to comply with the above and similar conditions, Whitlock engineers have developed the special type of combined storage heater and economizer shown in Fig. 7, page 9. This economizer consists of a large cylindrical steel shell in which is incorporated a heating element of copper tubing. This heating element is divided into two entirely separate compartments.

Service water, which is required in the building, is passed through the shell, entering it directly below the heating element. The hot condensation is passed through one compartment of the heating element, making several passes, and, due to the fact that this heating element is placed low in the shell, it is always in contact with the coolest service water. This insures thorough cooling of the condensation. An auxiliary supply of steam is introduced into the other compartment of the heating element.

In the storage type of heater, steam is frequently used at pressures considerably above atmospheric. In such cases, where the condensation is not returned directly to the boiler, it is a decided advantage to cool it well below 212 degrees before discharging to the receiving tank. In such cases also the steam heating and condensation cooling functions can be combined into a single "heating section" divided into two compartments — or what is known as a "divided" heating section. High pressure steam is used in one compartment, the condensation then being trapped and passed through the other compartment in order to cool it before discharge to the receiver.

Obviously, a table showing sizes of heaters required for all possible conditions would be of very large proportions. Table 6, however, gives size of cooling sections required under certain specific conditions (note that these sizes apply to the cooling compartment only). The sizes for conditions not listed will immediately be forwarded upon request. The size of the storage shell must be determined after analysis of the conditions under which the heater is to operate. The nearest Whitlock engineer will gladly assist in determining the size.

CAPACITY OF CONDENSATION COOLERS

Number Of Square Feet Of Radiation	Equivalent Condensation In Pounds Per Hour	Cooling Condensation 200°—125° While Heating An Equal Amount Of Service Water 40°—115°		Cooling Condensation 200°—100° While Heating Twice The Amount Of Service Water 40°—90°		Cooling Condensation 200°—89° While Heating 3 Times The Amount Of Service Water 40°—77°	
		Type "K" Cooling Section		Type "K" Cooling Section		Type "K" Cooling Section	
1000	250	H-0		H-0		H-1	
1500	375	H-1		H-1		H-2	
2000	500	H-1		H-2		H-3	
2500	625	H-2		H-3		H-5	
3000	750	H-3		H-4		H-6	
3500	875	H-4		H-5		H-7	
4000	1000	H-4		H-6		H-8	
5000	1250	H-6		H-7		H-10	
6000	1500	H-7		H-9		H-11	
7000	1750	H-8		H-10		H-12	
8000	2000	H-10		H-12		H-13	
10000	2500	H-11		H-13		H-14	
12500	3125	H-13		H-14		H-16	
13000	3750	H-14		H-15		H-17	
17500	4275	H-15		H-16		H-18	
20000	5000	H-16		H-17		H-19	
25000	6250	H-17		H-19		H-20	
30000	7500	H-18		H-20		H-22	
35000	8750	H-19		H-21		H-24	
40000	10000	H-20		H-23		H-25	

Table No. 6

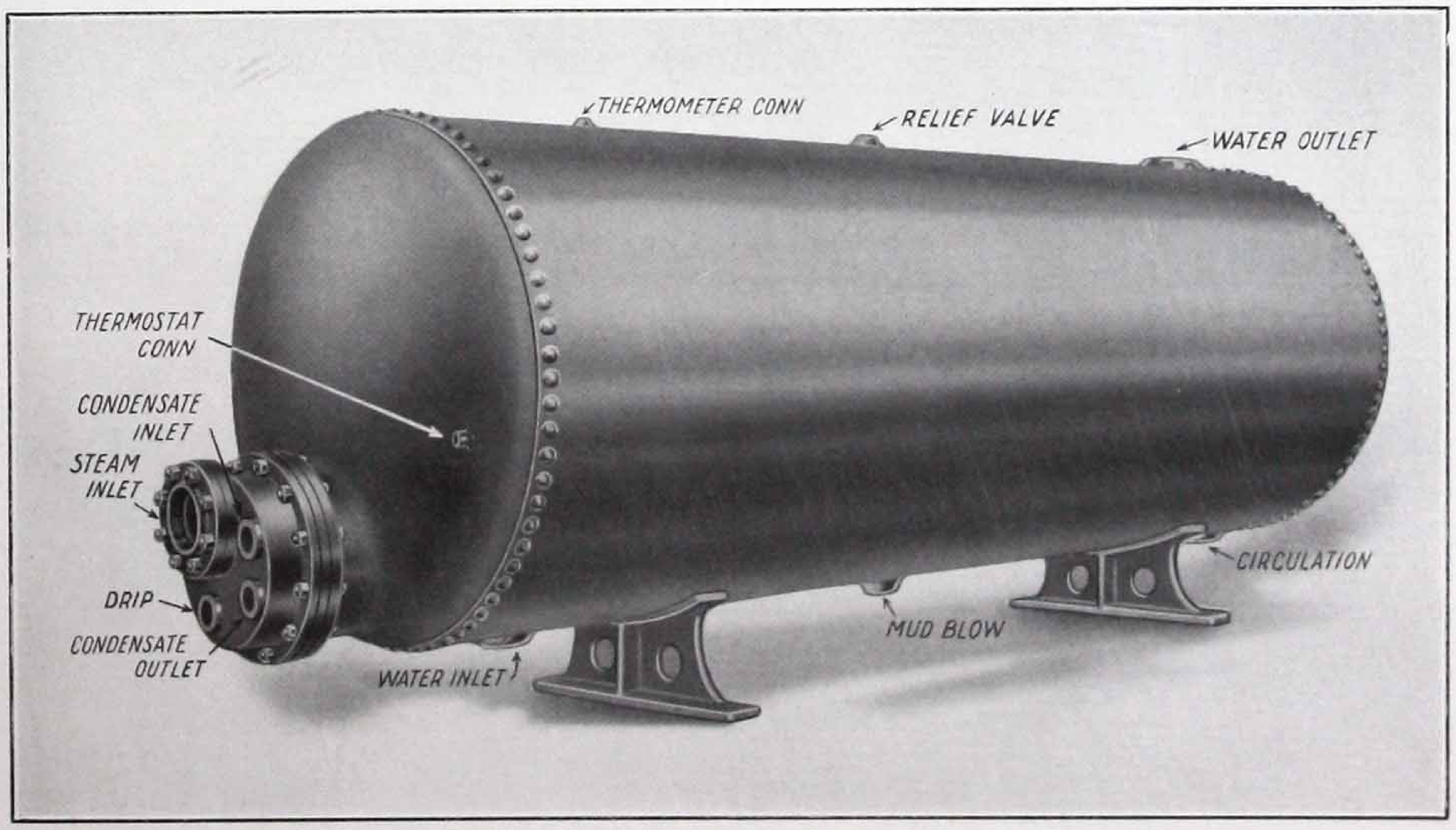


Fig. 7 — Type "K" Condensation Cooler

LEHIGH COAL & NAVIGATION CO.
COALDALE, PA.

B. & O. READING
RAILROAD TERMINAL
[illegible]
PHILADELPHIA, PA.

U. S. CAPITOL
WASHINGTON, D.C.

YORK GENERAL HOSPITAL
YORK, PA.

INSTITUTE of FINE ARTS
DETROIT, MICHIGAN

CITY HALL
LOS ANGELES, CAL.

U. OF P. STADIUM
PHILADELPHIA, PA.

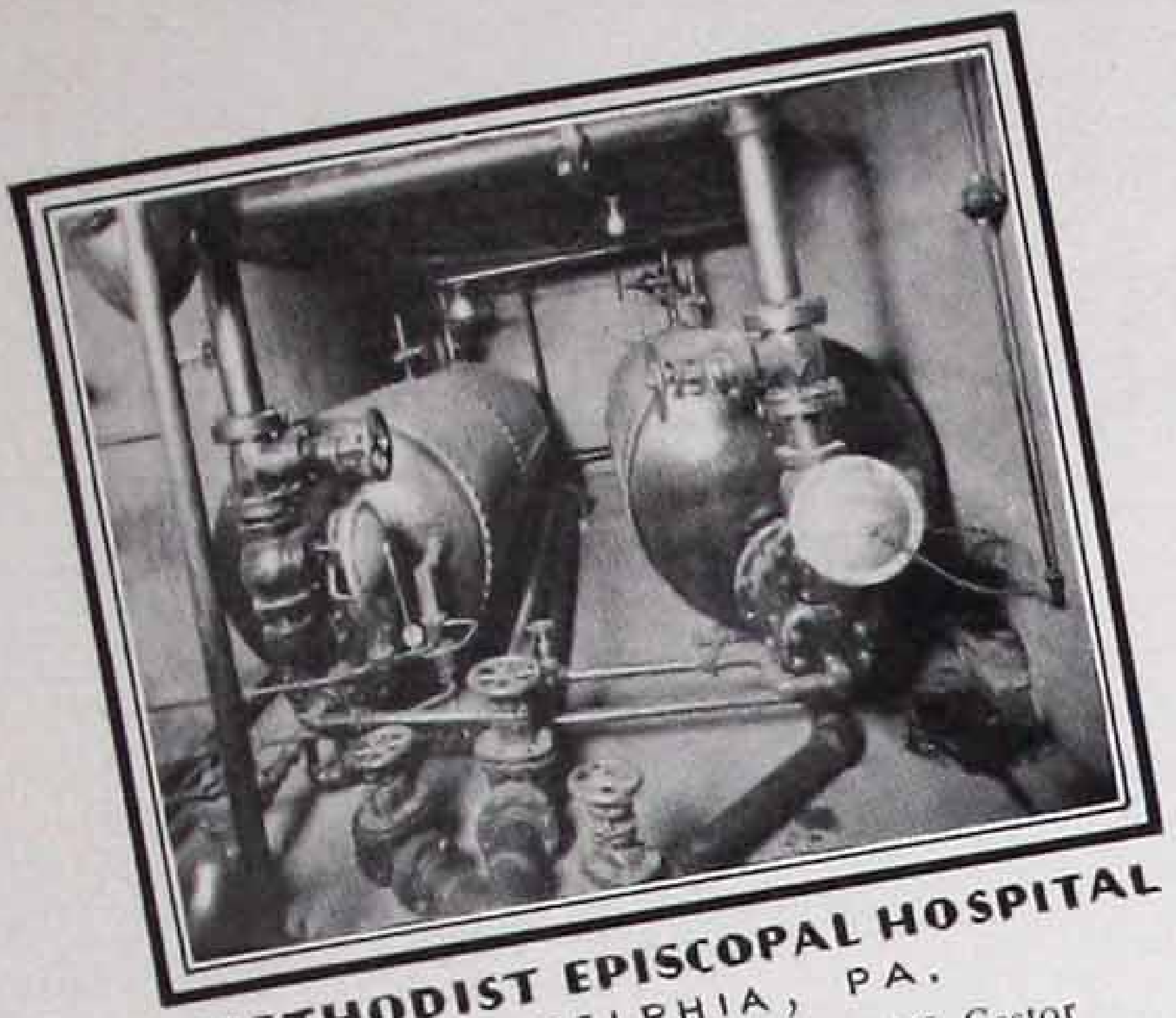
LITTLE FALLS LAUNDRY CO.
LITTLE FALLS, N.J.

AMBASSADOR HOTEL
ATLANTIC CITY, N.J.

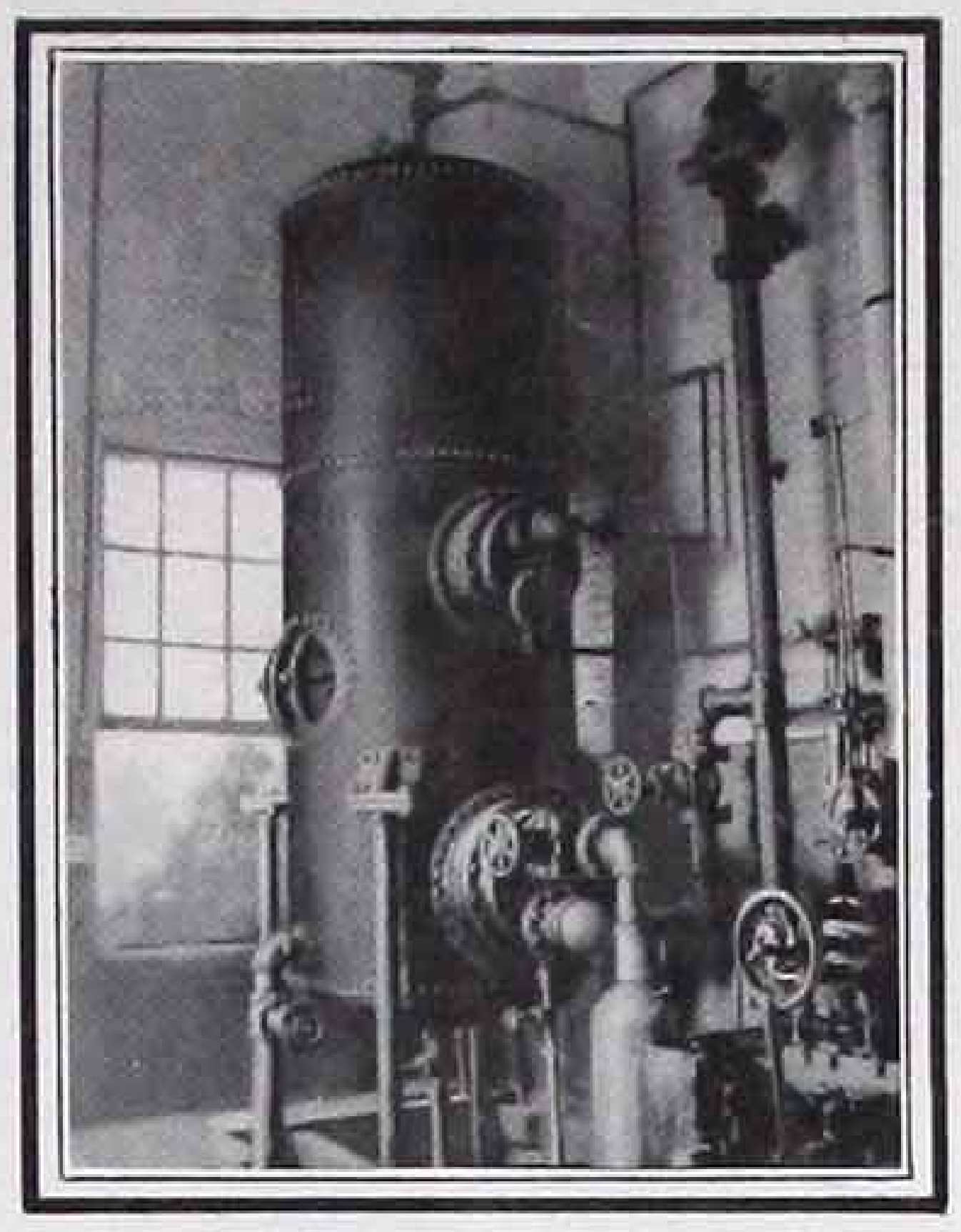
A few of the prominent buildings and plants using Whitlock Type "K" Heaters

CONVENTION HALL
ATLANTIC CITY, N.J.

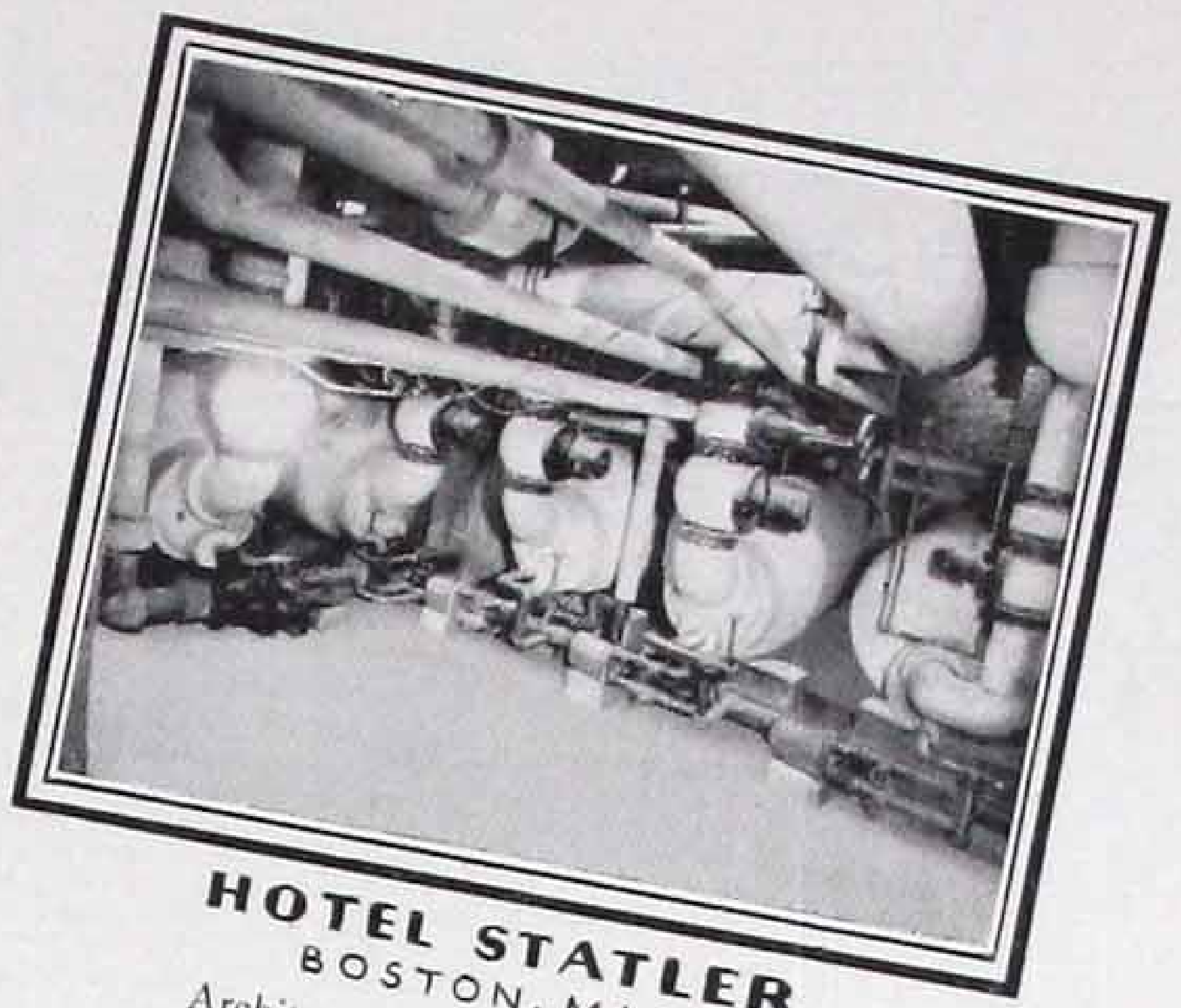
MIAMI-BILTMORE HOTEL
CORAL GABLES, FLORIDA



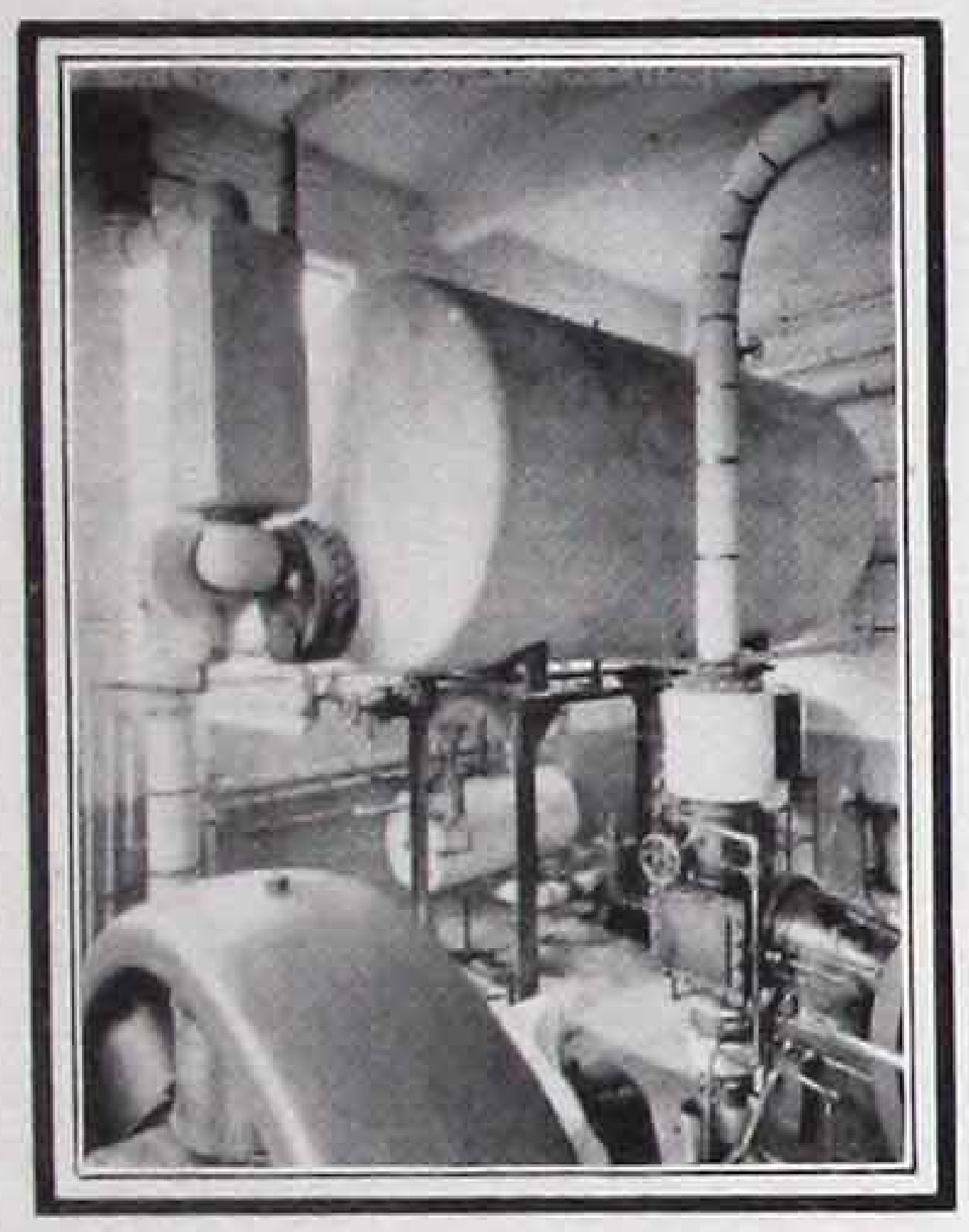
METHODIST EPISCOPAL HOSPITAL
PHILADELPHIA, PA.
Architect and Engineer, Horace W. Castor
Heating Contractors, S. Faith & Co.



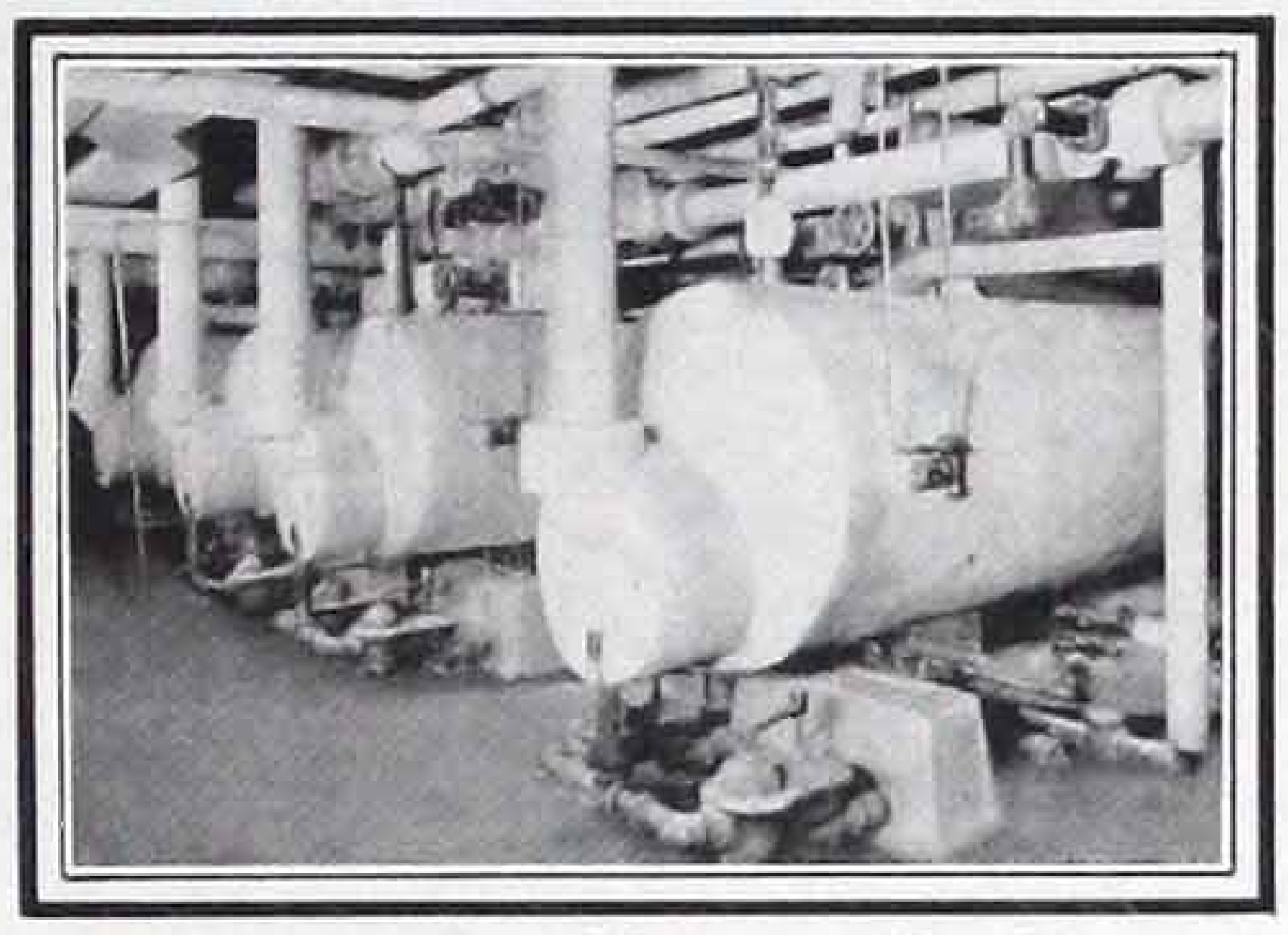
F. L. HERVEY & COMPANY
FALL RIVER, MASS.



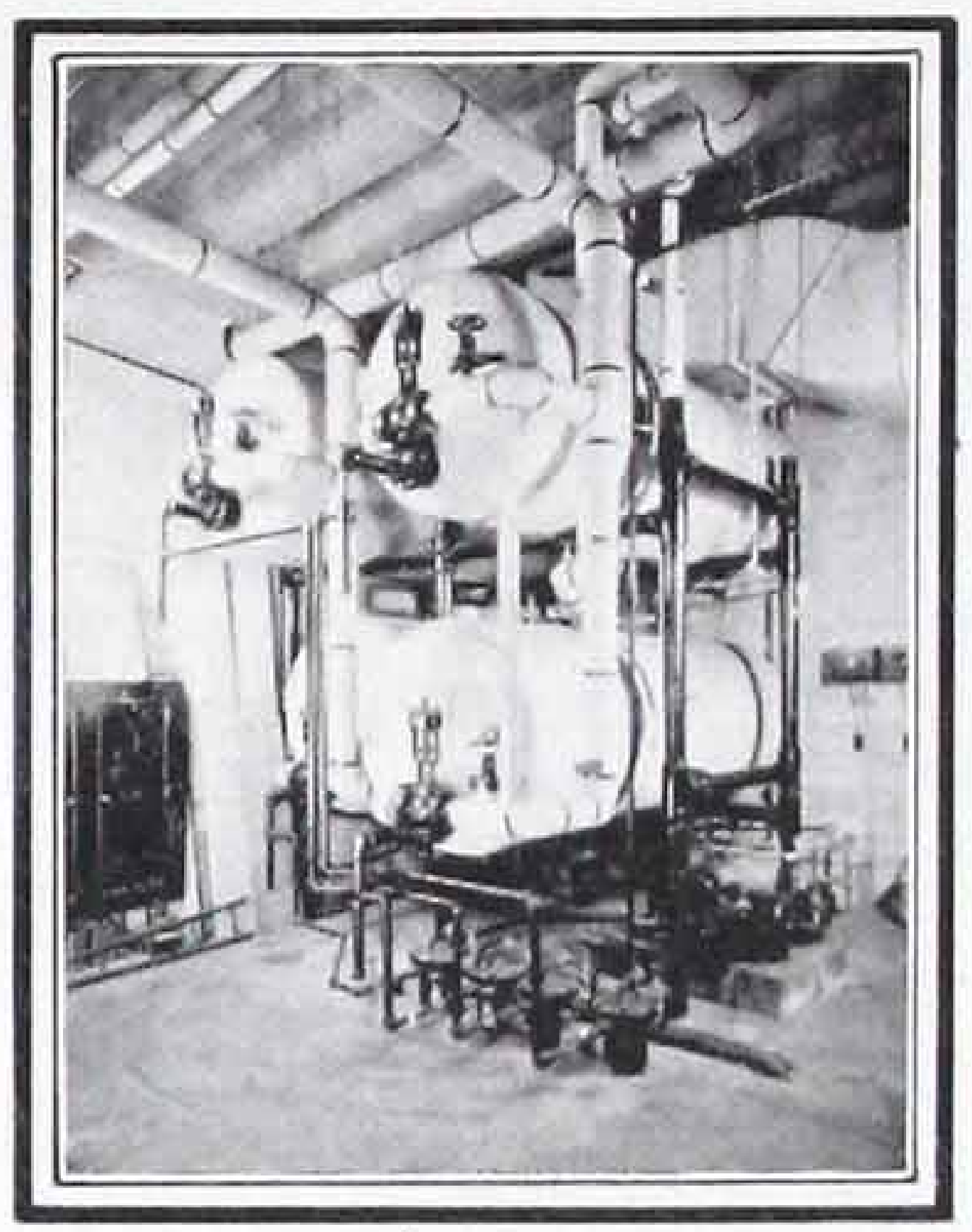
HOTEL STATLER
BOSTON, MASS.
Architects, George B. Post & Sons
Engineers, Tenney & Ohmes
Heating Contractor, John W. Danforth Company



MODERN LAUNDRY
PHILADELPHIA, PA.



MOUNT ROYAL HOTEL
MONTREAL, CANADA
Architects and Consulting Engineers, Ross & MacDonald
Heating Contractors, Garth Company

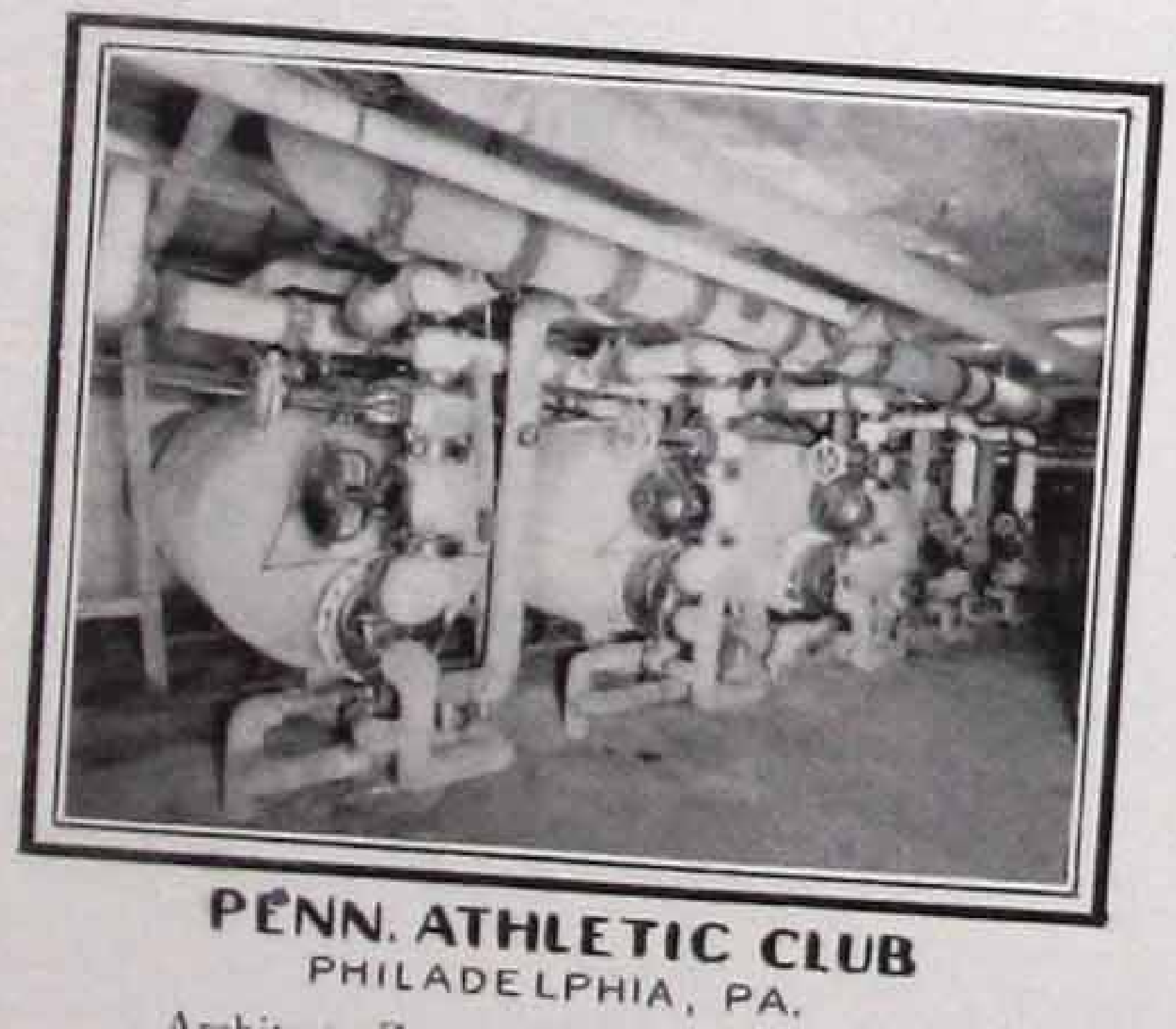


WOMAN'S CITY CLUB
SAN FRANCISCO, CALIF.
Architects, Bliss & Fairweather
Consulting Engineers, Leland & Haley
Heating Contractor, Atlas Heating & Ventilating Co.

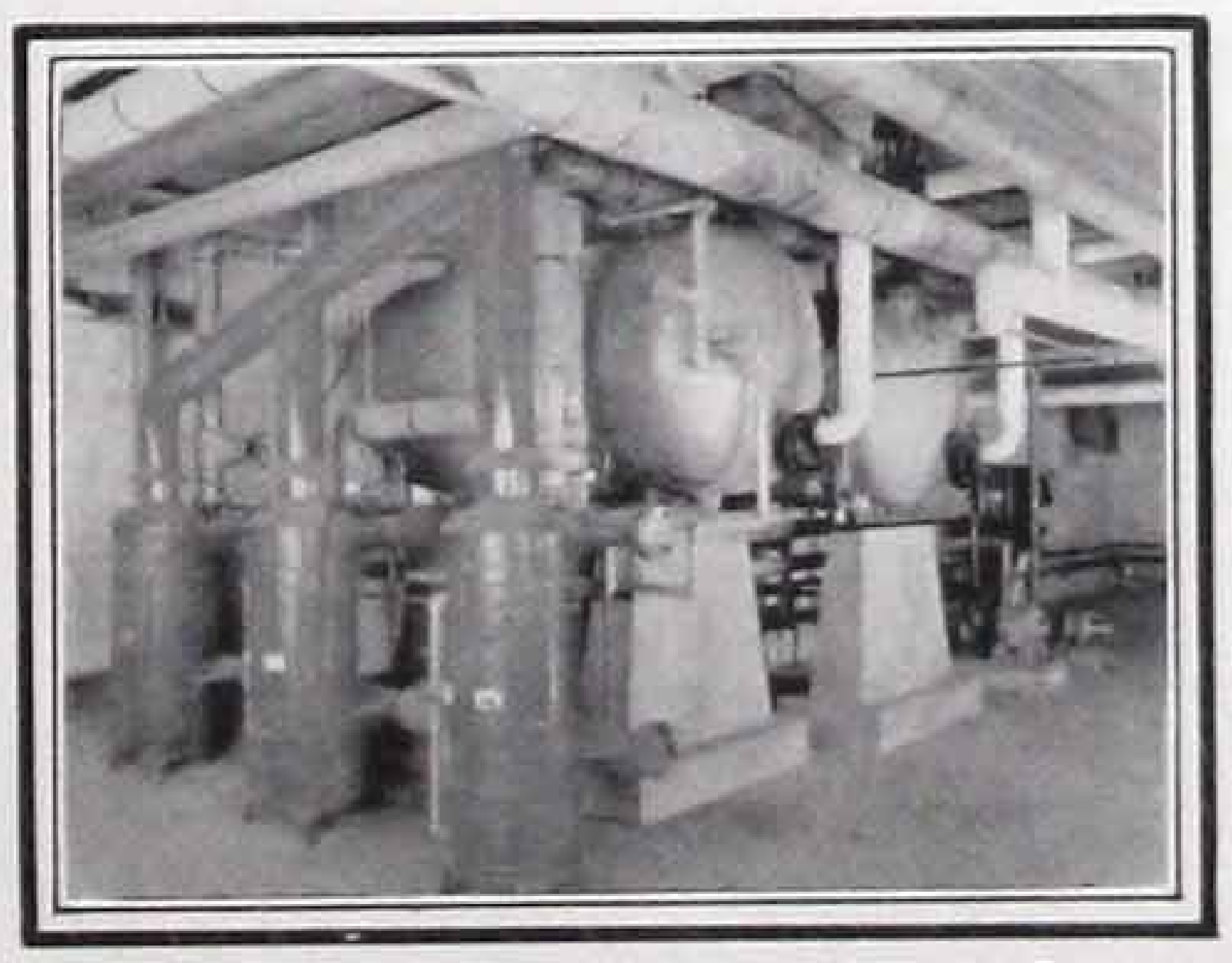
A few of the thousands of Whitlock Type "K" Heaters in various types of buildings

CENTRAL Y.M.C.A.
MINNEAPOLIS, MINN.
Architects, Shattuck & Hussey, Chicago, Ill
Associate Architect, Long, Lamoreaux & Long,
Minneapolis, Minn.
Consulting Engineer, Jas. B. Lund, Chicago, Ill.
Contractors, Hankee Heating Co., Minneapolis, Minn.

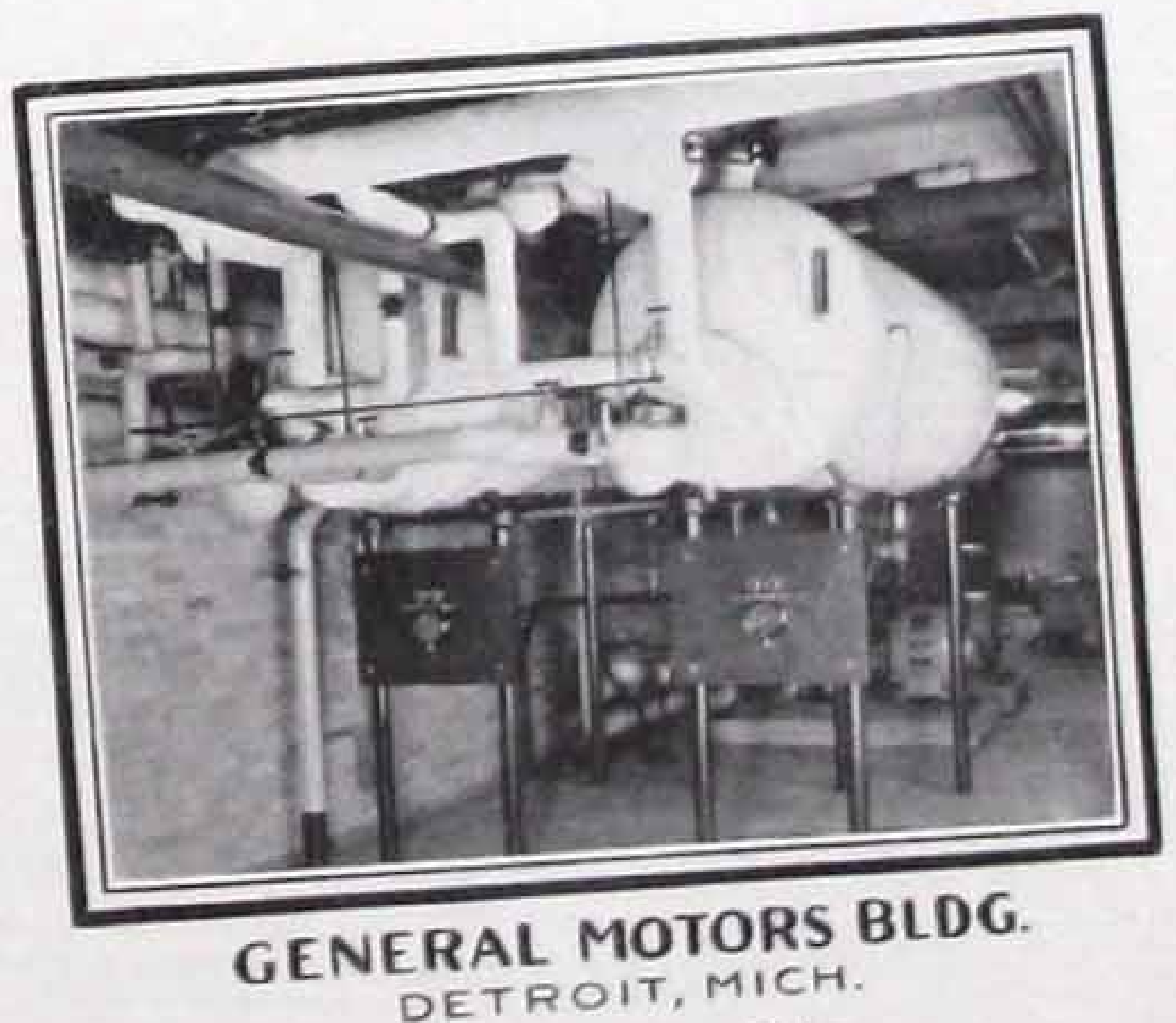
MEMORIAL HOSPITAL
WORCESTER, MASS.
Heating & Plumbing Contractors,
M. D. Holmes & Sons Co.



PENN. ATHLETIC CLUB
PHILADELPHIA, PA.
Architects, Zantzinger, Borie & Medary
Heating Contractors, V. N. Welamb Co.

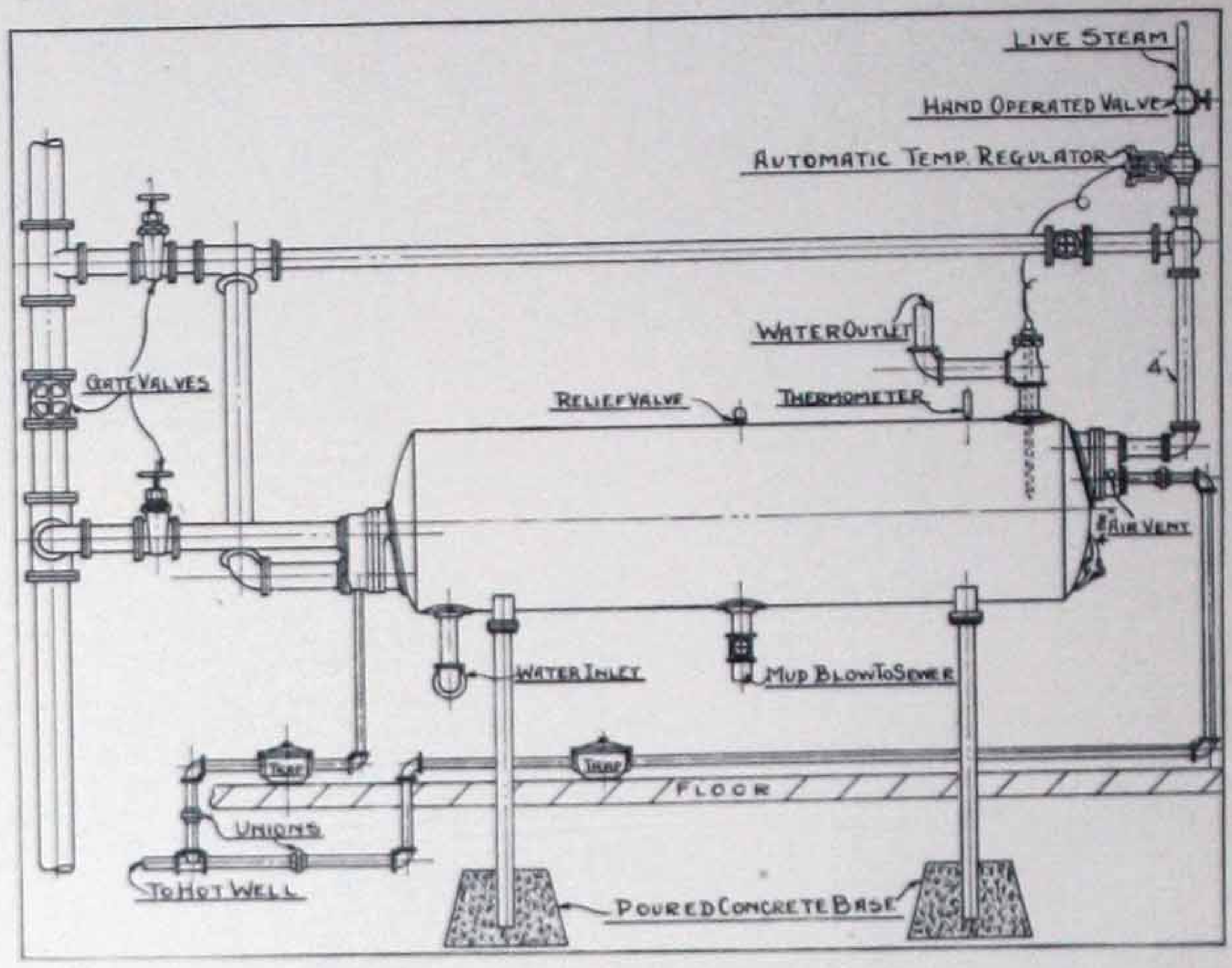


STATE CAPITOL BUILDING
LINCOLN, NEB.
Architect, B. Goodhue, New York City
Contractors, B. Grunwald Co., Omaha
Consulting Engineer, Werner Nygren, New York City

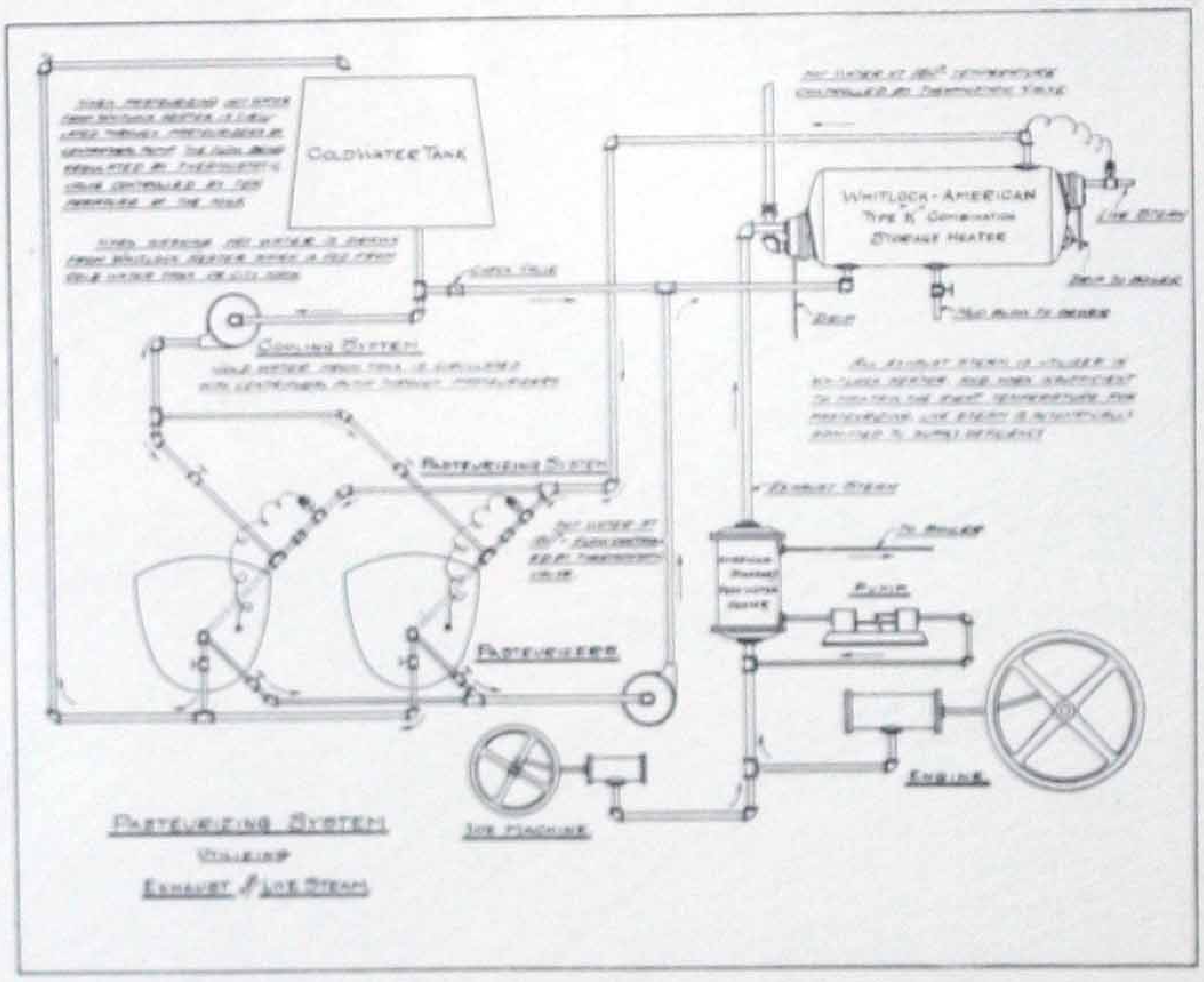


GENERAL MOTORS BLDG.
DETROIT, MICH.
Architect, Albert Kahn
Heating Contractor, T. J. Dyer Company

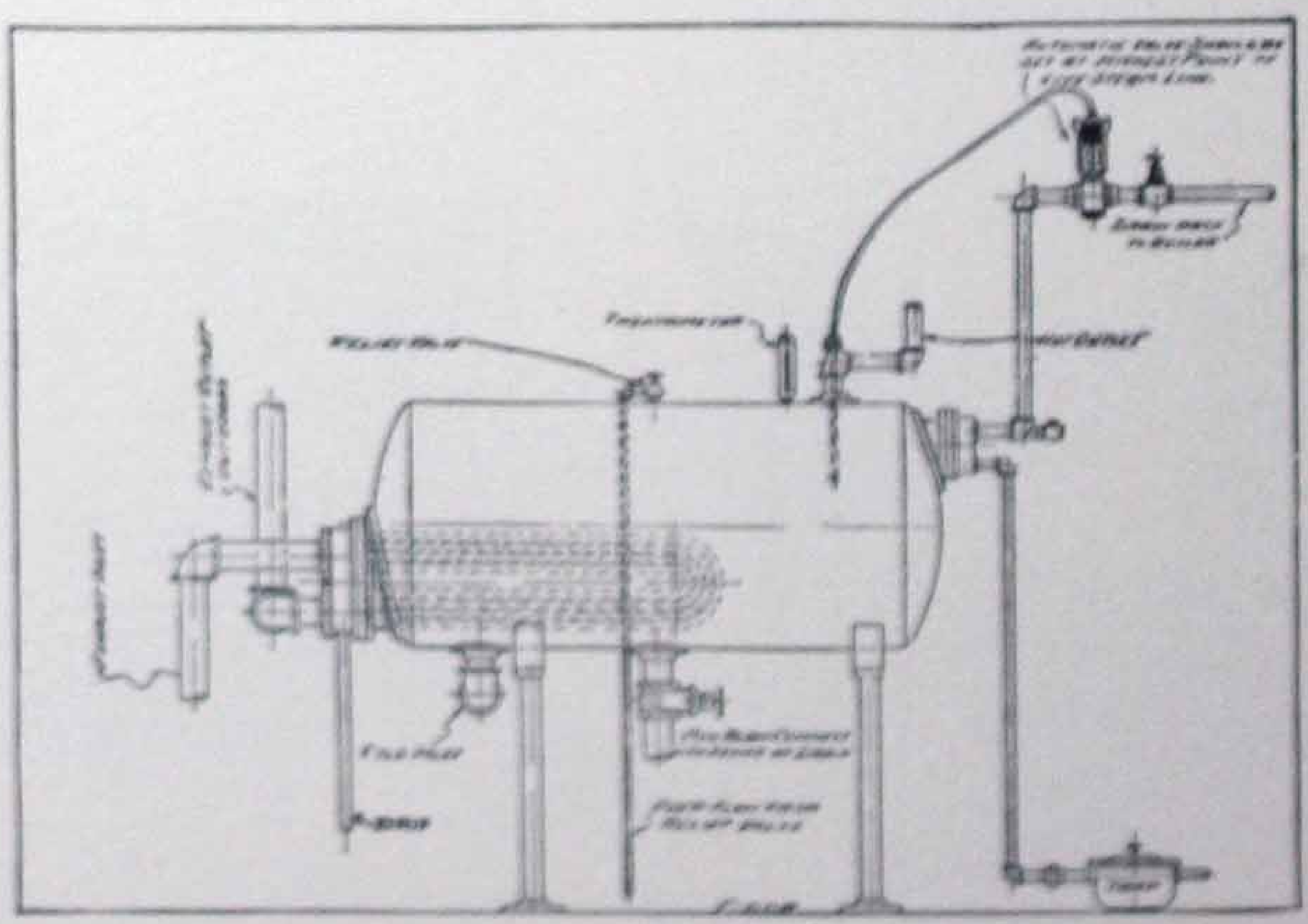
Diagrams of Typical Whitlock Type "K" Heater Installations



Typical installation of Type "K" Heater for supplying hot water to Textile Mill. Piped to use exhaust steam in both main and auxiliary heating sections, or live steam in auxiliary heating section.



Typical installation of Type "K" Heater in a dairy in connection with batch pasteurizing.



Typical plan of connections for combined Type "K" Heater using both live and exhaust — or high and low pressure — steam.

Details of Construction

Type "K" Storage Heaters

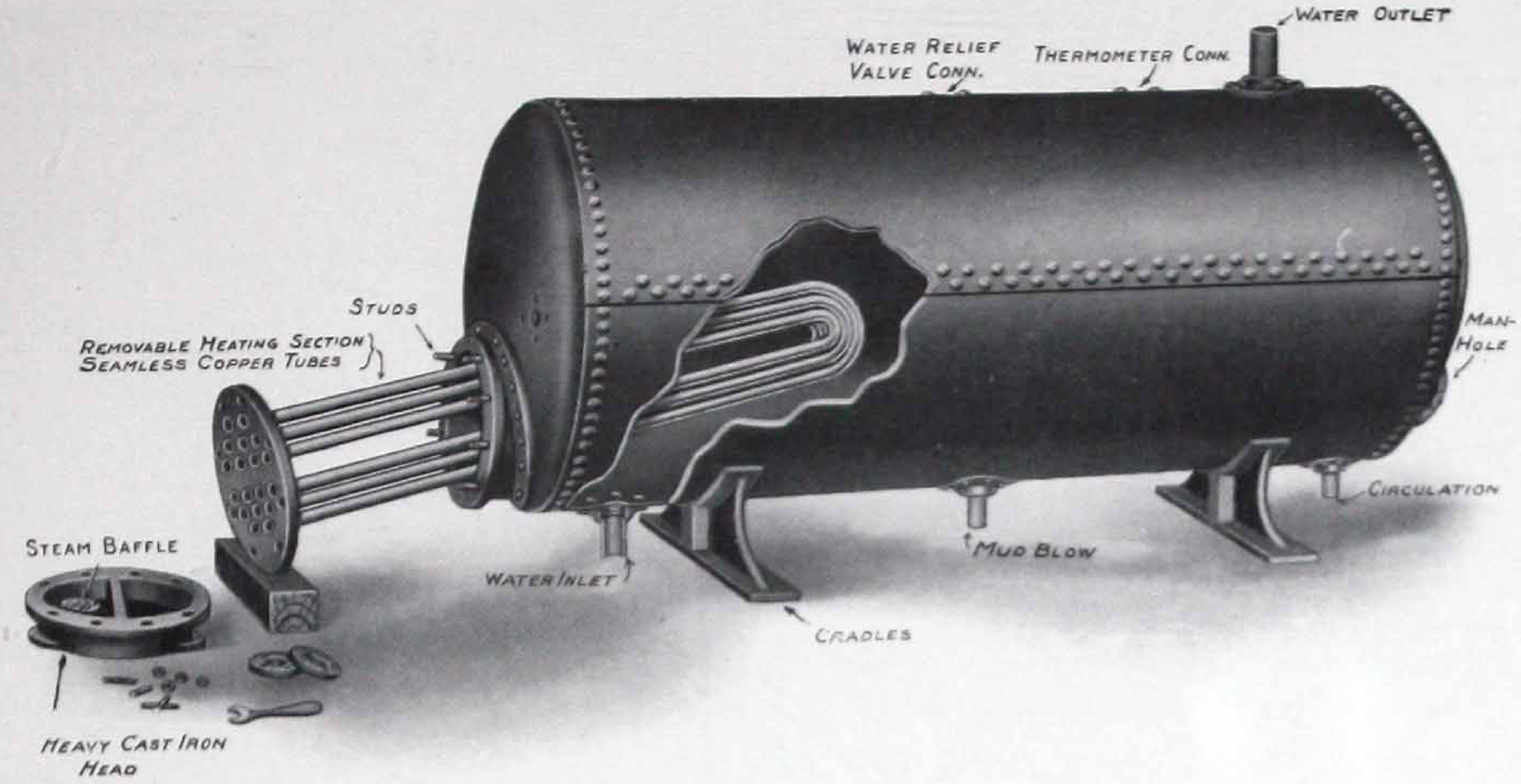


Fig. 8 — Type "K" Heater — Partly Assembled

Whitlock Type "K" Storage Heaters are well known for their particularly strong construction. The illustrations on this and following pages show a few of the details upon which this reputation is founded.

The shell is made to A.S.T.M. Specifications 78-27 of a thickness sufficient, not only to withstand the working pressure safely, but to resist the effects of corrosion over a term of years without becoming dangerously thin.

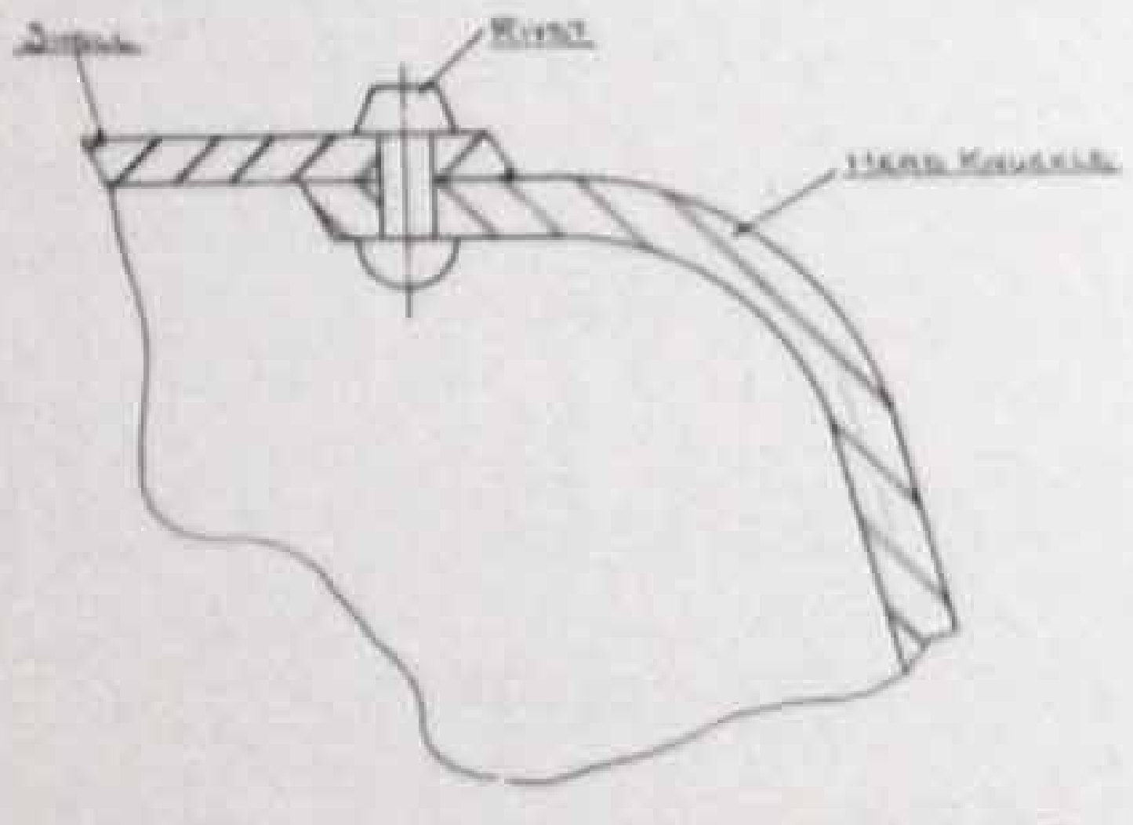


Fig. 9 — Cross Section through Girth Seam at Bumped Head. Single Riveted Lap Joint

Riveted joints are carefully designed to comply with the requirements for the particular job. For heaters up to and including 60 inches diameter and ordinary working pressures the girth seams are single riveted lap joints (Fig. 9) and longitudinal seams are double riveted lap joints (Fig. 10). Heaters above 60 inches in diameter and heaters of small diameter for high working pressures are furnished with triple riveted lap or double, triple or quadruple riveted double butt strap longitudinal seams.

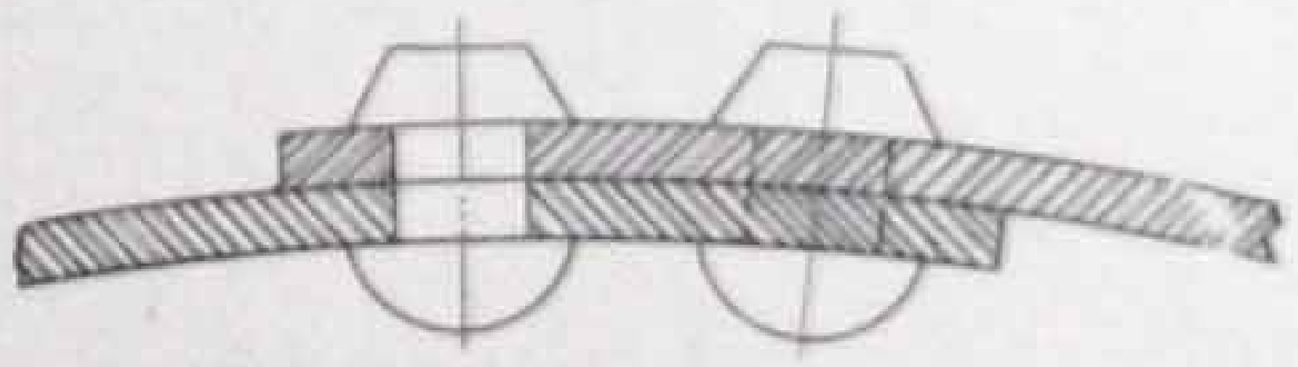


Fig. 10 — Cross Section through Longitudinal Seam - Double Riveted Lap Joint

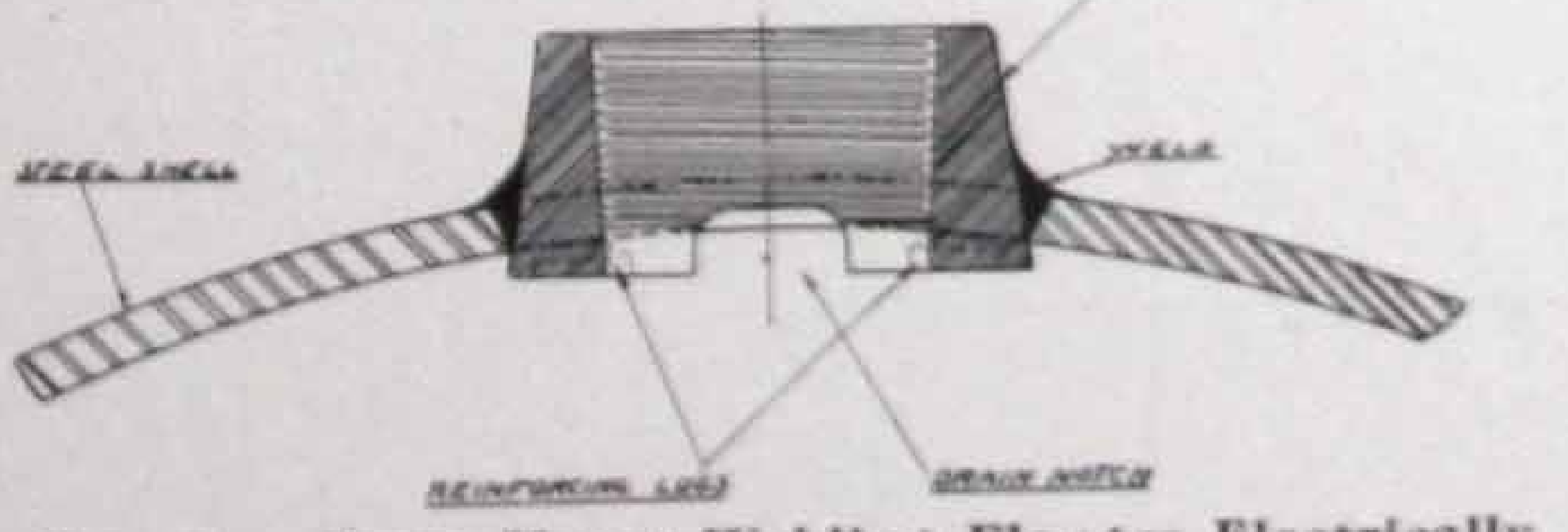


Fig. 11 — Extra Heavy Welding Flanges Electrically Welded to Shell

Water connections up to and including 4 inches diameter are screwed connections made to extra heavy welding flanges welded to the shell by the electric arc method (Fig. 11). Larger connections are flanged connections riveted to the shell as illustrated in Fig. 12.

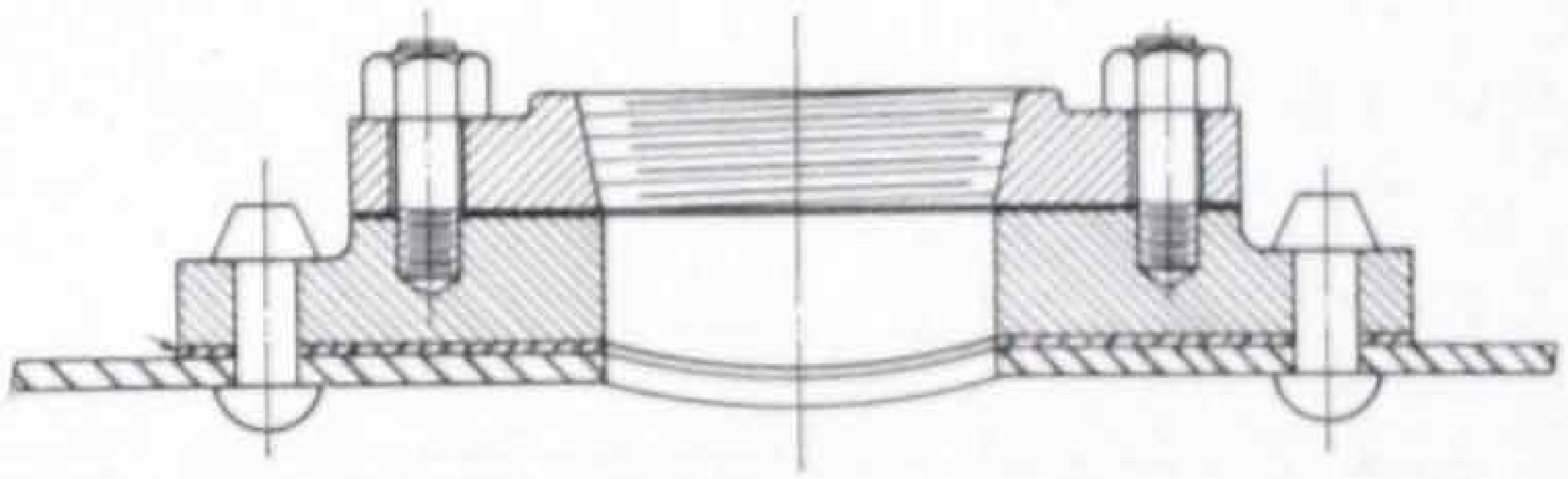


Fig. 12 — Cross Section showing Flanged Connection to Shell. Larger Size Water Connections

Thermometer, air relief, water relief and regulator connections are made through steel spuds welded in.

A standard 11 x 15 inch double yoke flanged-in manhole (Fig. 13) is provided in heaters 30 inches in diameter and over. This is located low in the rear head to allow easy access when cleaning the heaters. Smaller heaters are furnished with hand-holes.

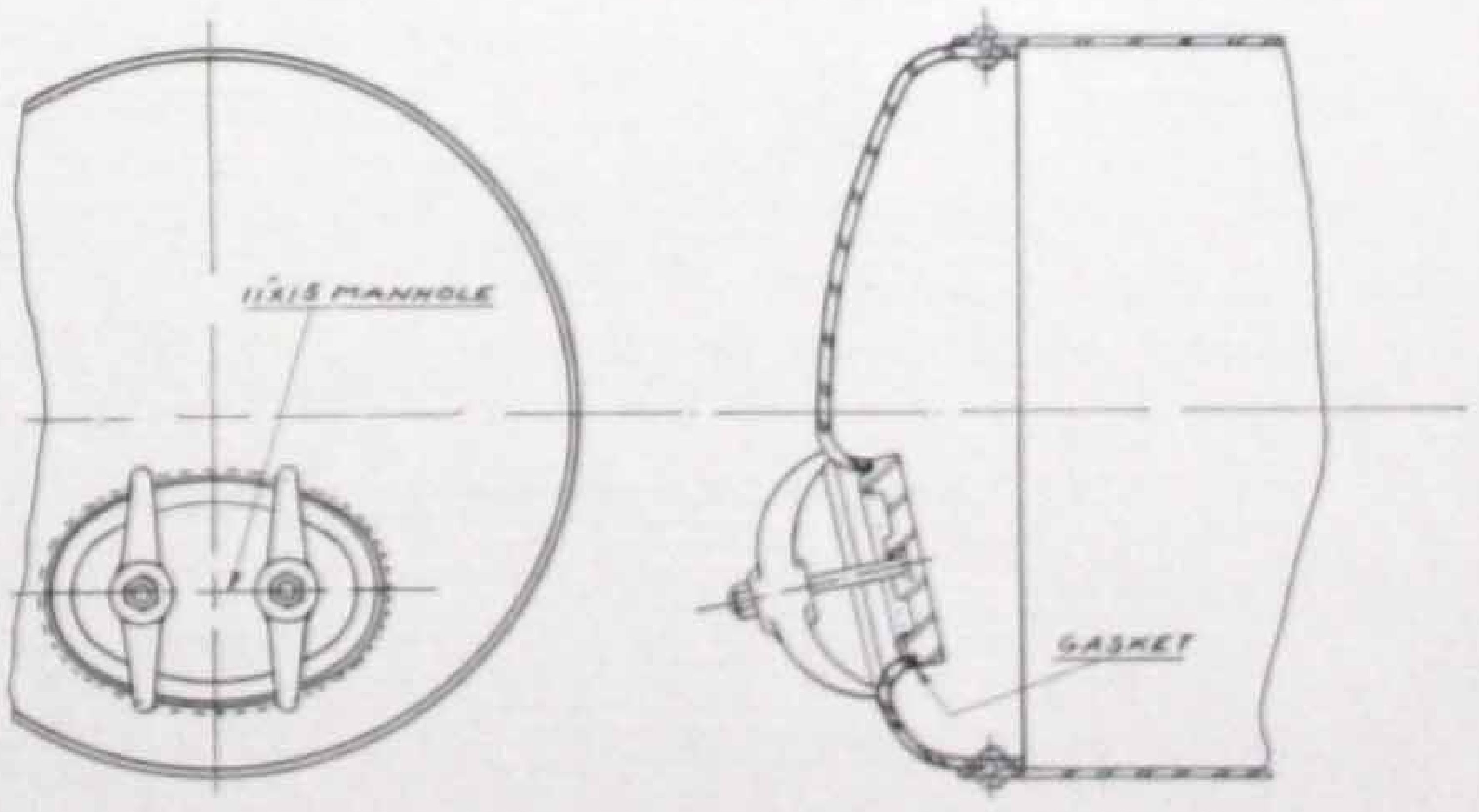


Fig. 13 — Manhole located low in rear head for convenience

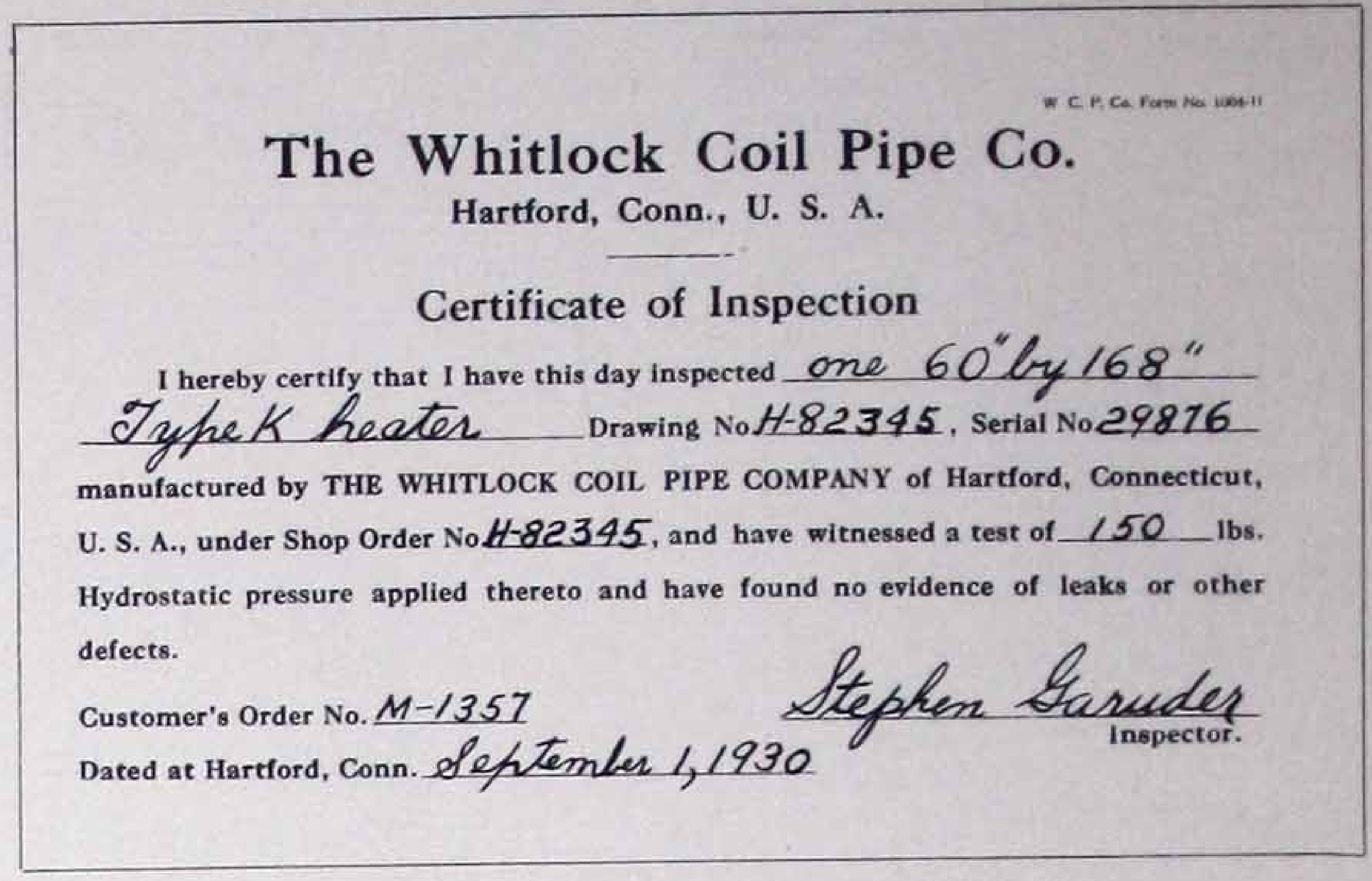
Heating Section

The heating section (Fig. 8) is made of U-bends of seamless drawn copper tubing firmly expanded into a heavy rolled steel tube sheet. Heating sections over 72 inches in length are firmly supported in the shell by means of a bronze tube support which has been described in detail under heading "Two Recent Improvements".

Head

The steam chamber or head is made of the best grade cast iron suitably ribbed to distribute the steam for highest heating efficiency. The head is bolted through the tube sheet and to the head port which is, in turn, riveted to the shell as in Fig. 15(a) or electrically welded to it as in Fig. 15(b).

While we are equipped to furnish either riveted or welded head ports, as the customer requests or as may be most practical, the welded construction, when carried out in accordance with procedure control, is fully as reliable as riveted construction, so that, unless otherwise specified, head ports are welded into the shells. Longitudinal and girth seams are, however, always furnished of riveted construction.



W. C. P. Co. Form No. 1004-11

The Whitlock Coil Pipe Co.
Hartford, Conn., U. S. A.

Certificate of Inspection

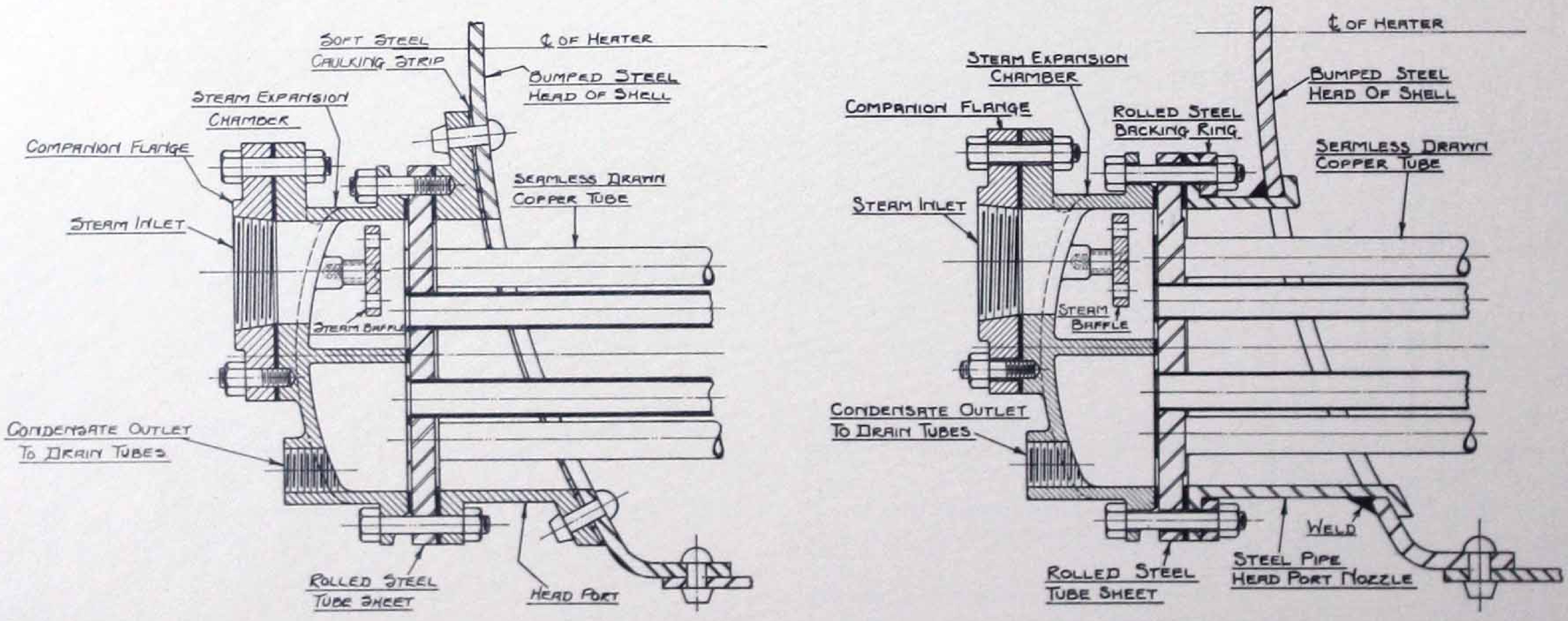
I hereby certify that I have this day inspected one 60" by 168" Type K heater Drawing No. H-82345, Serial No. 29876 manufactured by THE WHITLOCK COIL PIPE COMPANY of Hartford, Connecticut, U. S. A., under Shop Order No. H-82345, and have witnessed a test of 150 lbs. Hydrostatic pressure applied thereto and have found no evidence of leaks or other defects.

Customer's Order No. M-1357
Stephen Garuder
Inspector.
Dated at Hartford, Conn. September 1, 1930

Fig. 14 — Inspection Certificate

Tests

Especial care is taken in testing Whitlock Storage Heaters. Before shipment, both shell and heating section are submitted to a hydrostatic test pressure as required by the Laws of the State in which the heater is to be installed, with a minimum test pressure of 50% in excess of the working pressures specified. When the heater is found tight under this test it receives the Whitlock Certificate of Inspection (see accompanying reproduction) which is mailed to the customer with the regular shipping papers.


SOFT STEEL CAULKING STRIP
℄ OF HEATER
BUMPED STEEL HEAD OF SHELL
STEAM EXPANSION CHAMBER
COMPANION FLANGE
STEAM INLET
SEAMLESS DRAWN COPPER TUBE
STEAM BAFFLE
CONDENSATE OUTLET TO DRAIN TUBES
ROLLED STEEL TUBE SHEET
HEAD PORT
℄ OF HEATER
STEAM EXPANSION CHAMBER
BUMPED STEEL HEAD OF SHELL
COMPANION FLANGE
ROLLED STEEL BACKING RING
SEAMLESS DRAWN COPPER TUBE
STEAM INLET
STEAM BAFFLE
CONDENSATE OUTLET TO DRAIN TUBES
WELD
ROLLED STEEL TUBE SHEET
STEEL PIPE HEAD PORT NOZZLE

a — Riveted Construction

b — Electric Arc Weld Construction

Fig. 15 — Methods of Attaching Head Ports to Steel Shell

Specification
for
Whitlock Type "K" Storage Heaters

Furnish and install in (horizontal) (vertical) position as shown on plans one Whitlock Type "K" Storage Heater as manufactured by The Whitlock Coil Pipe Company, Hartford, Connecticut.

Capacity. The heater shall have a storage capacity of (   ) gallons. The shell shall be (   ) inches in diameter by (   ) inches long [Shell thickness* (   ) inches, head thickness (   ) inches] suitably riveted to stand a working water pressure of (   ) pounds.

† The heater shall be capable of heating (   ) gallons of water per hour from 40 degrees F. to 180 degrees F. when supplied with sufficient steam at (   ) pounds gauge pressure.

Construction. The shell shall be constructed of rolled steel plate in accordance with A.S.T.M. Specifications 78-27, with riveted seams properly designed for the specified working pressure. Necessary connections, of sizes recommended and guaranteed by the heater manufacturer for specified duty, and an 11″ x 15″ manhole shall be provided.

Heating Section. The heating section shall consist of seamless drawn copper tubing made up into U-bends with ends expanded into a single rolled steel tube sheet. The heating section shall be properly supported in the shell of the heater, shall be easily accessible and arranged so that the entire section can be easily removed from the shell for cleaning or inspection.

The steam distributing chamber or head, baffle at steam inlet, and supporting cradles (if horizontal type heater) shall be of the best grade commercial cast iron.

Test. Before shipment, shell and heating section shall be submitted to a hydrostatic test pressure as required by the laws of the State in which heater is to be installed — with a minimum test pressure of 50% in excess of the working pressure specified.

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* Refer to Working Pressure — Shell thickness table on page 4.

† This paragraph refers to heaters having a single heating section designed to use either live steam or exhaust steam at all times. These heaters are also furnished with two sections, if so specified. In this case the primary section uses what drips or condensation returns are available and the auxiliary section uses live steam under thermostatic control to complete the heating required. When this type of a heater is required substitute the following paragraph in the above specifications: —

The heater shall be capable of heating (   ) gallons of water per hour from 40 degrees F. to 180 degrees F. when the primary heating section is supplied with (   ) pounds of condensate at a temperature of (   ) degrees F. and the auxiliary heating section is supplied with steam at (   ) pounds gauge pressure under control of a temperature regulator valve of approved design.

Whitlock Heat Transfer Equipment

IN addition to the Type "K" Storage Heater, which is the subject of this bulletin, The Whitlock Coil Pipe Company manufactures equipment to take care of every heat exchange problem involving the heating or cooling of any liquid, gas or vapor while cooling or heating another liquid, gas or vapor. Due to the fact that almost every heat exchange problem differs from all others with respect to volumes of liquid, etc., passing through both the shell and tube sides, it is necessary that each heat exchange problem presented to us, be studied by Whitlock engineers so that the most practical equipment will be recommended, with a view to economical and efficient operation.

This plan, to design and construct each exchanger for the particular conditions under which it is to operate, and with regard to the purpose for which it is to be used, has proven to be the most logical in every way.

The following list indicates a few of the more important standard products of The Whitlock Coil Pipe Company. Bulletins covering these as indicated will be sent upon request.

Instantaneous Water Heaters — Bulletins 24, 25
Storage Type Water Heaters — Bulletin 40
Service Water Heaters — Bulletins 25, 40
Process Water Heaters for Laundries — Bulletin 42
Swimming Pool Heaters — Bulletin 25
Feed Water Heaters — Bulletin 13
Fuel Oil Heaters — Bulletin 31
Sprinkler Tank Heaters — Bulletin 32
Preheaters for Laundries — Bulletin 50
Special Heat Transfer Equipment — Bulletin 100
The Whitlock Unatherm Water Heating System — Bulletin 75
The Whitlock Preheaters — Bulletin 50

THE WHITLOCK COIL PIPE CO.

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Manufacturers of and Sales Agents for Whitlock Heaters in Canada
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